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Principal Contents

A Big Discrepancy Between 3% on Savings and 5½% on Bonds

IN the face of the high interest rate being paid by the Canadian government on our recent war loan and the suggestion of a new and larger bond issue, which presumably will be no less attractive to the investor, one is constrained to question the wisdom of our Department of Finance in their attitude towards the "savings" question, which, in-so-far as our post office and government savings regulations are concerned, amounts practically to a discouragement of thrift. We refer particularly to the very low rate of interest paid on post office savings, the placing of a too low maximum on deposits and the amount of red tape with which the comparatively simple operation of depositing or withdrawing money is surrounded.

"Thriftlessness" is poor recommendation for any individual or group of individuals and we believe our Government would have been well advised years ago in placing a little higher premium on thrift by making the sacrifice a little more worth while. As it turns out, our Dominion would have reaped the further advantage of being ready for this tremendous emergency. How much easier it would have made a $300,000,000 loan if our citizens had had this amount to their credit in the Dominion savings departments. How comparatively simple a matter it would be to get their consent to transfer from (say) a 4 per cent. or 4½ per cent. savings account to a 5½ per cent. bond. The whole trouble is that the money isn't there to transfer. Our people, prosperous beyond the average, have not been encouraged in thrift.

However, the past cannot now be remedied, but we surely can profit by the experience. Isn't there an unreasonable discrepancy between the rates paid by our Government in their savings departments and the rates paid on their bonds?

* * *

Suppose it is true that a loan of $300,000,000 will be offered six months from now. Wouldn't it be a good idea to start to save it up now—today? Wouldn't that be best accomplished by the Government offering an attractive rate of interest—possibly as high as the bond itself will carry? Wouldn't it encourage thrift? Wouldn't it mean a considerable nest-egg for the inevitable demand? Wouldn't it be schooling our citizens in the habit of saving? Wouldn't it in effect go a long way towards ensuring the success of the next loan?

There is much money in Canada, but there is much being spent on extravagances. It is all very well to argue and harangue with people to save their money. The easier it comes the easier it goes—has always been so and will always be so unless you make it worth while to save. This, we believe, the Government has in its power to do if it will act promptly now.

* * *

We suggest that the Government immediately take steps to induce the working people of Canada and others to save their surplus. If 4 per cent. won't do it, pay more. $300,000,000 means less than $40 a head for us. We can do it if the incentive is sufficiently attractive. Let the government stop playing with its 3 per cent. toy and offer a real inducement to the workman, now well supplied with money, to save his surplus. Under proper conditions and given reasonable notice there is no doubt this amount can be saved. Let us start now and let our Government make the first move.

Montreal's Fair Wage Schedule

The Montreal Builders' Exchange, through Mr. D. K. Trotter, the secretary, has made a vigorous protest against an attempt now being made to give a wider application to the fair wage clause inserted in Montreal municipal contracts for buildings, construction work, etc. This wider application will affect not only the building trades, but also those industries which are more concerned with the manufacture of dressed stone, hardware, iron goods, electrical fittings, etc., and which are delivered on the various civic jobs in a finished condition. The attempt is being made to insist that in the manufacture of these articles the wages noted in the schedule shall be paid. This is, says Mr. Trotter, "an entirely new interpretation, and one which, if conceded, will have a far-reaching influence on the various industries concerned. For example, it has been urged by those who are in a position to make their demands felt, that in the yards where dressed stone is prepared for city works the city fair wage be paid. Were all the dressed stone and finished stone from a particular firm being utilized on construction work for the city, no great difficulty would be experienced in meeting this demand, but when from the same yard we learn stone is being prepared for, say, Ottawa, Toronto, and other points, and that consequently planers and stonecutters are often employed during the course of a day on stone for different jobs and in different cities, it seems clear that the enforcement of such a stipulation will hamper the organization of a firm so engaged, causing needless expense and irritation, and within certain limits restraining the trade.

"In the case of other articles (e.g., hardware and electrical fittings) which are manufactured outside Canada and which, therefore, enter into competition with the home products, another difficulty is presented. Are Canadian manufacturers and sub-contractors to have thrust upon them an artificial and purely arbitrary scale of wages (as the present one is) while their competitors are free from this unhealthy interference?" Mr. Trotter has asked for the co-operation of other bodies in defeating this attempt to extend the scope of the fair wage schedule.

Wood Blocks on Grades

We published in our December 8 issue an interesting article on the use of wood blocks for city pavements, pointing out certain advantages which this pavement possesses over other types. In this connection the following remarks from Mr. A. F. Macallum, city engineer of the city of Hamilton, Ont., are of special interest. The city of Hamilton has used wood blocks on grades up to six per cent., and, with a special construction that has been found by the city engineer to be suitable under these circumstances, very satisfactory results have been obtained. The following brief discussion by Mr. Macallum on the use of creosoted wood blocks on various grades will be read with interest by engineers throughout the Dominion.

Creosoted Wood Blocks on Grades

"When the grade of a proposed pavement exceeds three per cent. the question of a suitable pavement, and the method to be adopted in laying it, to meet the requirements of the traffic, becomes of interest. With the variability of conditions to be met with, due to our climatic changes, the limits of most paving material is soon reached, so far as the inclination of grade is concerned, unless specially manufactured.

"The writer inquired from twenty-four cities to ascertain the maximum grades upon which creosoted wood blocks had been laid, and found that one city had laid this pavement on a seven per cent. grade, one on six per cent., three on five per cent., and five on three per cent. grades. The five to seven per cent. pavements were laid under two methods, described below.

"The first method used was probably originated in this city and was used on upper James Street with the block pavement laid there in 1909 on a five and a half per cent. grade. Each block had a piece one-half an inch in width and one inch in depth cut off one face, so that while the blocks were laid at right angles to the centre line of the street, there was a space of a half inch between each row of blocks giving a good foothold for the horse-drawn traffic. These blocks were pitch-filled and the cross grade of the street was sufficient to drain out any water.

"The same method was adopted on King Street West, in this city, during the same year, and I may say that both of these pavements have been very successful in meeting the conditions of heavy traffic on two of our main streets without a cent being spent for repairs or renewals since being laid.

"The special cutting of the blocks in the manner described added considerably to the cost of the pavement and to obviate this the ordinary rectangular block was later used with creosoted laths ⅜ in. x 2 in. laid between each cross row of blocks. This was pitch-filled, as in the first method, and has been just as successful. A part of John Street South, and Bay Street, each having a grade of five and a half per cent., paved in 1911, were laid in this manner, and are today in first-class condition, and subjected to fairly heavy traffic.

"On Ravenscliffe Avenue, a purely residential street, having a six per cent. grade, blocks spaced in this manner were laid. The reason for putting such a pavement on a street like this, having very little traffic, was that the residents insisted on a creosoted wooden block pavement because of its quietness as compared with other pavements suitable for such a grade, and it has fulfilled expectations.

"From our experience we have no hesitation in recommending such a pavement on grades up to six per cent."

Canadian bank deposits continue to increase rapidly and now total $1,120,954,457. This is made up of $406,735,171 demand deposits and $714,219,286 notice deposits, both highest records for the Dominion.

Proposed Bridge Over Sauvage River

The Quebec Streams Commission, Montreal, are calling for tenders for the construction of a bridge over the Sauvage River, in connection with the dam which is being built on the St. Maurice River. The bridge is to be built at a point where the river empties into Lake St. Francis, and will replace an existing structure which will be flooded when the dam is finished. The Commission are asking for alternative bids for a wooden bridge, wooden piers, and abutments and bridge approaches; and for concrete piers and abutments and bridge approaches and steel superstructure. The wooden bridge, designed under the supervision of Mr. O. Lefebvre, the chief engineer, will be 544 feet between the abutments, and will have four spans of 136 feet each, supported by wooden crib piers and abutments filled with stone. The detail design of the steel bridge is to be submitted by the bidders, but the main feature is a bridge with three spans of 180 feet each in length, supported by two piers and two abutments of concrete, resting on solid rock. The bridge will have to support a concentrated load of 30,000 pounds. The flooring is to be of red pine. When the tenders are in the Commission will decide on the type to be constructed.

"Punch"

The British Empire, and Canada its most important unit, faces the new year with unimpaired vigor, uncountable resources, unshaken confidence and redoubled determination.

Development of Canadian Highways

The Necessity of good roads for National Progress and Production—A saving of Time and Money in Transportation.

By W. A. McLean *

THE development of roads in Canada, in essential principles, has followed the history of all other countries in this regard; and the student of the question cannot but be struck by the similarity which has existed in all countries of the world. Canada has had

(1) A period of toll roads prior to 1850;

(2) A period of railroad construction when the common road was neglected but which has resulted in the construction of 32,000 miles of steam railway with a capitalization of $2,000,000,000 including three transcontinental trunk lines;

(3) A period of bicycle influence and agitation when educational measures and some better roads organization were inaugurated; and

(4) The period of motor vehicle influence, which has finally awakened the cities to the cause of good roads as a measure of national development and prosperity—the cost to be borne not by half or quarter of the community, those residing on the farms, but by every one receiving the benefits and carrying the responsibilities of citizenship.

This is the story which might be told of the United States—with variety of detail according to local conditions. Just as there has been difference of detail between the States of Massachusetts, of Maine and of Dakota—so have local circumstances influenced the progress and results of organization in the Canadian provinces.

Provincial Organization

The Dominion (Federal) administration to the present has done nothing for roads. Primarily the control of roads is vested in the local municipality within which they lie, but every Province has a provincial highway department, from which, in varying degree, centralized influence, assistance and authority is radiated to road improvement. All this is very similar to the general situation in the United States.

Roads in nearly all countries fall naturally into a three-fold classification. There are,

(1) The main roads between towns and cities;

(2) Leading farm roads, radiating from market centres and shipping points, and

(3) Local feeders.

The natural features of any country have been very largely, a controlling factor as to which of these classes of roads has received first or chief attention.

Thus, in the Province of British Columbia, traversed by the Rocky Mountains, with rich resources of mine and forest, and fertile valleys, the construction of main roads connecting centres of population has been a feature of the provincial road programme, and upon which there has been a recent expenditure of about $15,000,000.

The prairie provinces of Saskatchewan, Alberta and Manitoba, principally agricultural, (wheat growing and ranching) with very little road material, constitute an area of earth roads, in which the grader and log-drag are to the present the principal means of improvement. Nevertheless their expenditure on roads and bridges amounts to about $2,500,000 annually.

The province of Quebec is making a special expenditure of $15,000,000 on road improvement. A portion is being granted as aid to municipal construction; but in addition a considerable mileage of main road has been built which will provide an excellent tourist route when completed next year (1916). The trunk of this main road system under the control of the Province will consist of a route from the American boundary near Plattsburgh in New York State, thence northerly to Montreal, 39 miles; a road on the north shore of the St. Lawrence easterly to Quebec city, 151 miles (in adddition to 27 miles of existing toll roads); and from Quebec city south to the American border near Jackman in Maine, 92 miles. Another "regional" road reaches from Sherbrooke to Derby Line on the American border, a distance of about 33 miles. On this system of trunk roads nearly $4,000,000 has been spent by the Province. A feature of the Quebec aid to municipal construction is that, for substantial improvement, the Government will provide the necessary capital, charging the municipality 2 per cent. for a term of 41 years, the Government meeting the balance of interest and sinking fund. About $8,000,000 has been thus appropriated to the present time.

Prince Edward Island, the small island province in the Gulf of St. Lawrence, a fertile agricultural area, is principally concerned with earth roads, all under the direction of a Provincial Department.

New Brunswick is not as yet making any large expenditure, although the beneficial influence of a provincial office is being exerted.

Nova Scotia, the most easterly province facing the Atlantic, is not in a position to make large expenditure; but the Provincial Department of Public Roads is making excellent progress with the outlay available, more especially in the improvement of earth roads, and the construction of permanent culverts and bridges. The expenditure of that department for the current year will amount to about $635,000.

Organization in Ontario

Ontario is the leading province of the Dominion, and has every variety of territory and resource. Southern Ontario is probably the most densely occupied portion of Canada where in an area of about 40,000 square miles, there is a population of about 2,500,000, one-half of which is urban. In the southern and populous portion, which is chiefly agricultural, there is a municipal expenditure on roads in the open country of over $2,000,000 annually; while the province spends about $1,500,000 annually through three road departments, viz:—

(1) Subsidies to leading market and main roads in Southern Ontario. (To this I will revert later).

(2) Trunk colonization roads in Northern Ontario.

(3) Minor colonization roads in Northern Ontario.

No part of Canada, I would point out, is so favorably placed to finance the construction of main roads as are some portions of the United States—such States

*Engineer of Highways for the Province of Ontario.—Read before Worcester Good Roads Convention.

as Massachusetts, Connecticut, or New Jersey, which are small in area and contain numerous cities which contribute to the cost of rural roads.

Unfortunately and unlike the United States, the system of municipal organization has been such that all cities are wholly separated from the county and township in which they lie, and have escaped taxation for roads in the open country. This is a situation which recent legislation has sought to correct; and provision is being made that all cities shall contribute to the cost of leading roads within a reasonable suburban area.

County Roads in Ontario

Owing to the strong claims of agricultural communities, the assistance given by the Provincial Government to the better class of construction, has been largely confined to the subsidizing of leading market roads in each county.

Ontario has both township and county organization. Township councils are elected annually, and the reeve of each township, (town and village) is, ex-officia, a member of the county council. Township councils, primarily, have control of all the roads, but a county council is authorized to take over from the townships the leading roads of the county for construction and maintenance. To this system of county roads, the Provincial Government has heretofore paid one-third of construction cost only, but under legislation of this year, will hereafter contribute 40 per cent. of the cost of construction, and 20 per cent. of the cost of maintenance. More than half of the counties are operating under this plan with good results, and to the present time, a total of over $6,000,000 has been spent on the work. It is anticipated that, under the increased subsidy, the remainder of the Province will adopt county systems in a very short time.

Counties have been somewhat lethargic in adopting the plan; but having adopted it, and having completed a reasonable mileage, the method becomes very popular. Property along the improved roads has shown decided advance in value varying with local conditions from 10 per cent. to 40 per cent.

A favorable feature of the Ontario scheme is that, by requiring counties, at the initial stage, to adopt a comprehensive plan of roads, a well connected system finally results. The work is very often, to meet local feeling, carried on in short sections, but each successive council has a permanent plan on which to work. Construction is carried on under an engineer or superintendent appointed by the county council, but all is subject to the regulation and inspection of the Provincial Department of Highways. The provincial subsidy is paid annually as the work progresses.

A county council may issue 30-year bonds to meet its own proportion of the cost, but more commonly they extend over a 20-year period. Very seldom are bonds issued for the entire expenditure of the county but as a rule to supplement a sum raised by uniform county rate. A county system will usually include about 200 miles, or 15 per cent. of the total road mileage within the county. The completion of such a system may extend over eight or ten years, so that by levying a county rate of 1.5 mills annually on the assessment during that period, only a very small municipal debt need accrue. Largely for moderate farm traffic, the county roads are of gravel or broken stone, single track, except near cities, and cost from $2,000 to $8,000 per mile, according to local conditions and traffic.

Assuming a county system constructed in ten years at a cost of $800,000 with a county assessment of $30,000,000, the annual arrangement would be as follows:—

Direct levy of 1½ mills on assessment	$ 45,000
Bond issue	3,000
Provincial subsidy, 40 per cent. of total	32,000
Total	$ 80,000

Thus in ten years (with proper maintenance additional), the county would have an asset in road improvement of $800,000 with a bond issue of only $30,000. To the latter is commonly added the cost of heavy machinery and permanent bridges, on which the provincial subsidy of 40 per cent. is also paid.

Bond issues for county roads are met on the annuity instalment plan. The sinking fund method has been almost entirely abandoned in the province for all municipal purposes, except in the larger cities. The annuity instalment plan is cheaper than the sinking fund method, safer, more easily managed, and is distinctly in favor with financiers, municipal authorities and the public.

Main Roads in Ontario

Under new legislation for main roads, more attention will be given to the development of certain trunk lines, for which there is a growing demand. The chief of these connects Ottawa on the east with Windsor (opposite Detroit) on the west, a distance of about 500 miles. A branch, 75 miles in length, would reach to the Quebec boundary (45 miles from Montreal), and another would reach from Hamilton to Niagara Falls, 45 miles. This road would form an ideal trunk highway for the southern part of the province. It would link up the various systems of county roads, would pass through the most important cities, and within twelve miles on each side is about one-half the population of the Province. Some portions of this road are now in fair condition with good gravel or broken stone surface.

The most important section, about 36 miles between Toronto and Hamilton, is now being constructed in a thoroughly substantial manner, with 4 per cent. grades, 26 feet between shoulders, and an 18-foot concrete pavement. The cost of the Toronto Hamilton section will be about $800,000 and the work is to be completed next year (1916). Other portions of the highway are now under consideration, and the linking up of the entire trunk highway is, we believe, merely a matter of reasonable growth.

The system of management provided for this class of road is somewhat unique. A main road is interpreted as one running directly between two important terminal points or cities, and therefore passing through a series of municipalities. Such series of municipalities may petition the Provincial Government for construction as a Main Road; and if the petition is endorsed by three-quarters of the municipalities affected, the Government will make surveys, prepare specifications and appoint a special board of Commissioners to take charge of the construction and maintenance of the road. The cost in the engineer's report is apportioned among the municipalities benefited, (the Government contributing 40 per cent.) and the Commissioners then act as a Court of Revision to hear the appeal of any parties affected as to the engineer's apportionment of the cost. The Commission may confirm or revise the engineer's report, and unless a majority of the municipalities then petition against the work, the Commission is authorized to proceed with construction.

Classification in Ontario

It will thus be seen that, in the Province of Ontario, the three-fold classification so desirable in road organization is being evolved in the following manner:

(1) Main trunk roads to be constructed and maintained by Special Commissions, under the guidance of the Provincial Highway Department; the cost to be met by Provincial subsidy and direct assessment on cities and rural municipalities benefited.

(2) Leading market roads, to be under the control of county councils, subject to regulations and inspection of the Provincial authorities; the cost to be met by Provincial subsidy, and county levy on all assessible property within the county, including cities.

(3) Local feeders, to be under the control of township councils, and at the expense of the township.

A Permanent Executive Staff

A difference between Canadian and American methods, with which I have frequently been impressed, is the Canadian tendency to greater permanency in tenure of office. In the American States, when a change of government takes place, a complete change of executive staff very often follows. This unfortunate political influence is no doubt recognized, and the mass of your citizens would desire to have it eliminated.

Under representative party Government, party influence cannot, and if clean and sane, need not be wholly eliminated. There is probably no important Highway Department in the world from which politics is wholly removed. But the party that does not recognize the necessity of a permanent executive force, is blind to its own best interests, as much as to the public good.

The difficulty would appear to be a failure in your organization to distinguish between "political" and "executive" responsibility; the one framing and determining a policy, the other carrying out that policy. The purely political head of a department is part of, and properly changes with each new administration. But the executive head and staff should be permanent, if reasonable efficiency is to be secured.

A permanent executive force, appointed "for life and good conduct," is the only means whereby skill, experience, and definite knowledge of local conditions can be brought into play. An experienced staff is the heart and soul of successful road system of the older countries, and should be incorporated into the highway administration of this continent as quickly as possible.

A feature of even the purely municipal road systems of Ontario, is the endeavor to create and retain permanent, and therefore, experienced men for every branch of the work. Public opinion in the United States would do well to insist on building up a permanent executive force in every branch of highway work, whether state or municipal.

What Will Good Roads Mean to the Dominion?

What Good Roads mean in point of present organization has already been outlined. What they will mean of advantage to the country might also as readily be applied to the United States.

In the Dominion of Canada there are about 250,000 miles of graded roads. Road-building is a slow process, and in most countries it has taken half a century at least to provide adequate surface construction. The immediate objective in Canada should be to substantially improve about 16 per cent. of the total, or 40,000 miles, which would carry the more concentrated market or farm traffic, while about 2 per cent. additional, or 5,000 miles should be treated in a trunk road basis. The total cost might be approximately estimated at $250,000,000 of which about $50,000,000 has been spent. The ideal of expenditure to be aimed at for this work of main road improvement (apart from small repairs and maintenance), would be about $15,000,000 annually or $2 per capita of population.

This is a substantial programme for a population of 7,500,000 people. It indicates one reason why road-building is a slow process—because it is expensive. It means that the work must be distributed over a term of years and among various administrative organizations. But so distributed, and looked at from the standpoint of annual ability, the undertaking becomes less difficult. The total twenty-year cost of maintaining a household does not worry the average man—if his annual income is sufficient for the annual outlay. Road-building is a continuous work; if properly carried on, is cumulative in its growth, and is a question of annual expenditure available to meet direct outlay, plus sinking fund, interest and cost of maintenance.

Saving in Transportation

Canada is a country of rich and varied resources. But natural resources are of value only as they are developed. A considerable part of the cost of such development is in transportation—in transferring goods from one place to another. The lessening of the cost of transportation, is a measure of economy, of national thrift, which will produce a large return in the expenditure. On this continent, the cost of team haulage is rarely less than 25 cents per ton-mile and is sometimes twice that amount. Under the favorable conditions of good roads in Europe, the cost is reduced to between 8 and 12 cents a ton-mile.

The tonnage carried over the country roads of Canada is not readily estimated; but railway statistics show that the total amount of freight carried by the railways and originating in Canada, is about 60,000,000 tons. This, for the most part, at one or both ends of the railway journey, must pass over the wagon road. And a considerable additional amount, consumed locally, passes over the wagon road without railway transportation. The average wagon haul for farm and natural produce is estimated at between seven and eight miles. It is probably a moderate assumption for Canada that a total of not less than 100,000,000 tons passes over the roads of the country with an average haul of five miles. If then the premise is true that good roads would effect a saving of ten cents per ton-mile, an adequate system of improved roads would create a profit of $50,000,000 annually on the produce and merchandise now passing over them.

The time lost in travelling over bad roads is very great. It is a fair estimate that bad roads occasion a loss of a man and team for two weeks (12 working days) annually to the average farm. With over 700,000 occupied farms in Canada, this wasted time and effort, if put into road construction, would substan-

(Continued on page 17)

Semi-rapid Transit Scheme for Toronto

Report just handed into City Council advises expenditure of eighteen million dollars — Toronto not ready for complete subway system

As a deliberate discussion of traffic conditions and requirements in the city of Toronto based on authoritative data gathered with apparently infinite care, no previous report approaches in value that just handed in to the City Council by Commissioner of Works R. C. Harris, F. A. Gaby, Chief Engineer Hydro-electric Power Commission of Ontario, and E. L. Cousins, Chief Engineer Toronto Harbor Commission. The report takes cognizance of general conditions covering a very wide range such as growth of population; location of factories; congested traffic points; vehicular traffic; Toronto Railway System; municipal car lines; Hydro Radial possibilities and many other minor factors which may influence the transportation requirements of the city of Toronto during the next quarter of a century. A rapid transit scheme, in the strict meaning of the term, is not recommended, but three trunk radial entrance lines with the necessary yards and terminal as shown in the accompanying drawing. This recommendation is based on the supposition (1) that the city of Toronto acquire the property of the Toronto Street Railway in 1921 and (2) that the waterfront viaduct will be constructed by the Grand Trunk and Canadian Pacific Railways.

The recommendations in the report are as follows:

1. The City of Toronto acquire the Toronto Railway Company at the expiration of the franchise in 1921, and thereafter operate same as a municipal railway.

2. The City should at once make a definite declaration of policy in this regard.

3. If the decision be to municipalize the service, preparatory steps should immediately be taken, in order that upon the date of franchise expiry, the City may enter into occupation and operation, without overholding tenure complications.

4. A Transportation Commission be at once appointed, consisting of representatives from the City, the Toronto Harbor Commission, and the Ontario Hydro Electric Power Commission, so constituted as to afford the City majority representation. This Commission should be vested with all necessary power to plan, control and direct all transportation and terminal facilities of every kind whatsoever, (exclusive of existing steam railways), including present or projected municipal lines within the corporate limits of the municipality, and to prepare and arrange for the acquisition and operation of the Toronto Railway Company as a municipal utility, upon expiry of the franchise rights of said Company; the powers of this Commission to be sufficiently inclusive to embrace all railway transportation facilities as aforesaid, and to be implemented from time to time in order to accomplish the full intent of this recommendation. The Harbor Board and the Ontario Hydro Electric Power Commission, should be represented upon this Commission in extension of the policy of Council already expressed in the appointment of the Board charged with the duty of making this report, and for the same reasons which guided that body in the constitution of such Board, viz.: That the future transportation facilities within Toronto should be co-ordinated with regard to the services, rights and holdings of the bodies aforementioned, with particular reference to radial entrance and railways, the operations of the Harbor Commission as Trustees for the City, and local street railway service within the City Limits. The Ontario Hydro Electric Power Commission, through their Municipal Radial Railway project, is at present undertaking the construction and development of some 1,000 miles of radial railways, with Toronto as a main terminal focal point; the Harbor Commission as Trustees for the City, control the proposed east and west trunk radial railway entrances, together with the proposed terminal site, contemplated team track delivery yards and general sorting yard, while the City has jurisdiction over all public streets, embracing surface, elevated and underground rights. Even cursory consideration, will demonstrate the necessity of harmonizing all these interests, if transportation problems are to receive adequate and effective treatment. This can best be accomplished by the creation of a Commission constituted as recommended

5. The construction of the three radial entrance lines, with necessary yards and terminal, as shown on Drawing No. 18 be proceeded with when conditions warrant and finance permits.

6. A rapid transit system in the strict meaning of the term be not adopted.

7. The radial railway trunk line entrances be used for a semi-rapid transit service, as conditions warrant, to serve the population in the districts lying at present without and adjacent to the existing City Limits.

8. It may be necessary to procure legislation amending existing Acts, in order to give effect to the foregoing.

9. The use of any of the lines, yards, terminals and anything whatsoever, in any way relating or appertaining thereto, by any other railway than those of the Hydro Electric Railway Union and the City, shall not at any time be permitted, until such railway shall have obtained the consent of the Hydro Electric Power Commission thereto.

10. We do not make suggestion as to finance and reimbursement, feeling that this does not lie within our jurisdiction, but is for each to take up with his respective principles.

These recommendations are based on certain conclusions drawn by the members of this Advisory Committee as a result of their researches and deliberations. These conclusions, in part, are to the effect that there is no congestion on Toronto's streets that cannot be relieved by a proper utilization of existing surface lines; that an up-town terminal is not feasible; that ample provision must be made for future expansion and for co-ordination of rail and water transportation; also that the present gauge on the Toronto Street Railway tracks must, for a proper traffic unification, be reduced to standard. The following are the conclusions in full:

Conclusions

After detailed consideration of the various factors, entering into and affecting the problem as hereinbefore recited, we have concluded that:

1. Additional civic car lines laid between now and 1921, without the limits of 1891, but within the limits of 1915, will, after acquisition by the City, of the Toronto Railway Company in 1921, adequately serve all sections within the present City limits: the maximum time necessary to reach extreme destination being thirty-five minutes.

2. The existing surface system of the Toronto Railway Company, if provided with improved equipment and operated at higher service efficiency can be made to adequately serve the City within the limits of 1891.

3. As traffic officers become more efficient in direction and citizens better appreciate the functions of such officials, the movement of rail, vehicular and pedestrian traffic will be

greatly facilitated, with consequent saving of time and added safety to all.

4. If a sufficient number of cars of modern type were provided, thereby minimizing overcrowding and the public educated to embark and debark with reasonable speed, it would result in more rapid operation of the railway system, and the facilitation of other classes of traffic.

5. There is comparatively little congestion in Toronto streets. This may be further minimized by regulation of standing vehicles on, and diversion of slow-moving, heavily laden traffic from, main heavily-trafficked thoroughfares in the central area.

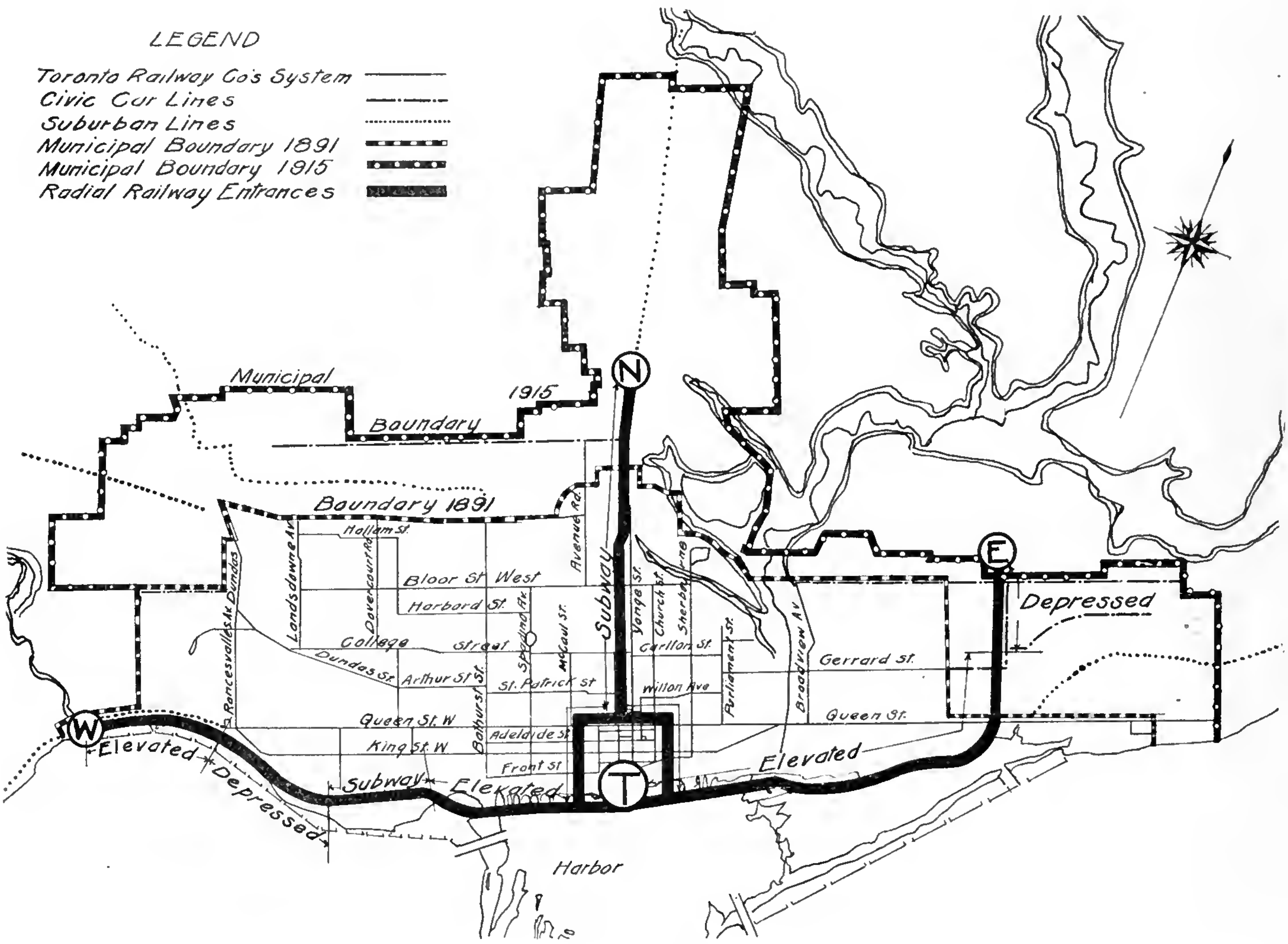
Radial Railway Entrance

1. That the following railways entering the outlying portions of Toronto, viz:—

(a) The Toronto & York Radial Railway embracing the Metropolitan, running north on Yonge Street; the Kingston Road line from the Woodbine; the Port Credit line from Sunnyside; (b) The Toronto Suburban to Lambton, Weston and Woodbridge, from Keele and Dundas Streets, cannot be considered rapid transit interurban lines, as in all cases they operate mainly on the highway, at low speeds. The people of Toronto and the Province have not had the advantages of modern rapid interurban service, such as is operated in many parts of the United States. When the Hydro Radial project becomes an accomplished fact, the system of which the section operating between London and Port Stanley is a happy augury, the entire population of the Province will derive therefrom, tangible benefits, which result to a community from a modern, high speed, properly equipped and efficiently operated system.

2. That the most feasible entrances from the east and west lie along the waterfront route. The entrance from the north may be readily effected by subway construction. The foregoing conclusions were arrived at after careful reconnaissance of the possible routes of entrance for radial railways, in the City and its environs, and detailed survey of one hundred and fifty miles of line.

3. From the viewpoint of economy of operation and utility, it is essential that the terminal be located on the axis of maximum movement. Having regard for the past suggestions for an up-town terminal, we thoroughly investigated this possibility, with the result, that aside from operating considerations, the additional cost of $8,000,000 embracing a four track subway from the waterfront to College Street, and the erection of a terminal at the latter point, proved it unfeasible.



Drawing No. 18.

The foregoing indicates the necessity for location on waterfront route.

The same consideration applies also to the location of yards on the waterfront property, in view of its natural advantages.

4. It is prudent to make present provision for future expansion covering trackage for trunk line entrances and terminal facilities, therefore the necessary sites should now be provided for ultimate development.

5. That it is necessary to make ample provision for the co-ordination of rail and water transportation and the proper interchange of all traffic.

6. The radial railway trunk lines should. as the future

(Continued on page 12)

The Quantity System of Estimating

A plea for a more economical system of figuring the Cost of Buildings—Make plans and specifications definite

By G. Alexander Wright

The ever-increasing amount of unproductive time, and usually money, which contractors are called upon to expend in preparing, gratuitously, quantities, as well as prices, often for an owner's benefit, suggests that the time has arrived when all concerned should take up, and seriously consider, the possibility of adopting a modern and more sensible system of estimating, such, for example, as has been long in successful operation in older communities. Not a mere copying of such methods, for I advocate the creation of a standardized method of our own—an American system, practical above all things; a system that will be in line with our otherwise progressive building methods; a system that shall be clear and accurate, and that shall stand for square dealing between contractor and owner—in short, a system that shall give every man his due, no more and no less; a progressive system, free from the defects of other systems, such as unnecessary elaboration, and yet one that will reveal to the bidder, at a glance, the actual quantity of material and labor in a structure, in any individual trade. When bidders are invited to submit bids, they are theoretically asked, of course, to submit competitive prices, but in actual practice their bids are based upon competitive quantities, before the competition in prices commences; which, in my opinion, is as unjust to the contractor as it is ridiculous. A building can only contain a certain amount of material, and no amount of figuring by contractors against each other can make that quantity any more or any less. Where, then, is the sense in a dozen or more general contractors competing against each other in taking quantities? One or more bidders, through being hurried, or being unable to take off the quantities accurately, leaves something out. What happens? Their bids are consequently low, and the owner benefits, at the low bidder's expense, whilst the competent or more careful bidder loses the job, because his quantities are more accurate, or because there may have been room for uncertainty when figuring the plans and specifications.

Antiquated Estimating Practices

Not long ago, a general contractor (whom I have known over twenty years) told me that if contractors figured to do competitive work just exactly as plans and specifications called for, a man would not get "one job in fifty." Now, if this is true, and personally I believe it is, there is something very rotten in our methods. In my judgment it lies in our antiquated estimating practices.

Those of us who know something of the unsatisfactory conditions under which bidders are often obliged to figure, time after time without result, have realized that hundreds of thousands of dollars in time and money are taken from contractors' pockets every year, simply because they do not, so far, limit competition between themselves to the matter of prices. They go on competing, and I suggest gambling, with each other as to the quantity of material a building will take, whereas I contend that that is a question of fact, and that competition in the quantities between contractors never can, and never will, in any way, change the fact that a certain fixed quantity of material and labor is necessary to do every job. There can be no legitimate competition in taking off quantities of materials, except that unfortunate competition which bidders make themselves when they take off too much, or, as too often happens, too little.

The legitimate competition can only come in where one man can handle a job better than another, or one man may have some advantage over another in buying, and so forth. All this kind of competition is legitimate enough, but it must be obvious that no amount of figuring can reduce the real quantity of material which a building will take, and so my contention is that it would be proper and fair to start all bidders figuring upon the same basis, by furnishing each with a schedule, or bill of quantities, showing accurately and clearly the different quantities and kinds of materials which the bidder is invited to figure upon; and even then there would be plenty of competition left, in placing profitable prices against each item.

Present Method Wasteful

Our present method (or rather, want of method) in estimating, and the rapid strides being made in construction, are, as I have said, forcing upon the contractor, more and more every year, an increasing waste of time and money in figuring out quantities. This senseless waste and competition cannot go on for ever. It has already brought men to bankruptcy all over the country, and has often prevented the making of a proper and legitimate profit among those who do succeed in keeping their heads above water.

This is a live question, and it deserves the earnest consideration of all contractors' associations and architectural societies from the Atlantic to the Pacific Coast.

No new or untried principle is involved. It is simply that of a definite quantity of work, for a definite amount of money. In substance the owner says, "I want this quantity of work done. The drawings and specifications show you how this quantity of work is to be assembled or put together. Now, tell me how much money will this cost? I want you to do the quantity of work called for; no more, no less."

At present, the successful bidder often says, in effect, to an owner, "I will erect your building according to plans and specifications," but—mentally—he says, "I do not figure that it will take as much flooring, concrete, plastering or painting as my competitors think it will!" Let me ask, Is this a proper or fair competition between contractors themselves? Is it fair to their own interests? There is only one individual who stands to gain anything under such imperfect methods, the owner, and not always he.

It may be stated that the Quantity System is equally applicable to engineering works, such as railroad work, sewerage disposal schemes, canals, pumping stations, etc.

Before proceeding to a further consideration of this subject, I may be pardoned perhaps for expressing the opinion, after having had over twenty years' intimate experience with the workings of the Quantity System of estimating, and over another twenty years in San Francisco (without any such system), that I know of nothing in connection with the work of the contractor that would be more beneficial than the adoption of some equitable recognized system of estimating upon bills of quantities, and these latter would be equally valuable, whether sub-contracts were eventually let or not.

It is not the idea that we accept the methods of any particular country—the author hopes he is too much of an American citizen to suggest that—but where contractors in older communities favor a certain system to the exclusion of the very thing we practise here, then I suggest that we might well stop for a moment and take notice of what is being done. For example, in the year 1909 a conference was held in Great Britain between the National Federation of Building Trade Employers, the Institute of Builders and the London Master Builders' Association, and a resolution was adopted recommending contractors who were members of these powerful organizations to decline to bid in competition against each other, unless bills of quantities were supplied for their use at the owner's expense. A deputation from these contractors' organizations afterwards attended before the principal body of architects, who promised to further the aims of the contractors as far as was within their power; and to-day the Quantity System is in full operation, not only in the case of private owners, but in all building work for government and municipal authorities, and upon the principle that it is impossible to obtain accurate bids without accurate quantities.

There must be some good reason for all this, and I suggest that it is worth consideration by any body of men, architects or contractors, who are endeavoring to get and to do better work, and thus elevate the building business to the honorable position which it is entitled to occupy, and to bring about such conditions as will cause owners to hold the competent architect, as well as the contractor, in higher esteem, and not regard him, as is too often the case now, with suspicion.

Existing Conditions

Now let us consider, for a moment, a few of the disadvantages of existing methods:

First—The time usually given for figuring is far too short for the accurate taking off of quantities, in addition to the pricing and figuring out of the many items. A bidder usually has contract work in progress, and other matters to be attended to during the daytime; other plans are to be figured by a certain time, and but little can be accomplished in the eight-hour working day, and so advantage must be taken of the night hours, sometimes all night, and even Sundays (as I happen to know), and any other time. Only those who have worked under these conditions and over blue prints at night, hour after hour, taking off items, can appreciate the many difficulties, pitfalls, and liability to error through figuring against time, after the real work of the business day is over. But the plans must be returned first thing in the morning, or the bid must be in by a certain hour the next day. Nothing but hurry—hurry—hurry. In not a few cases more information is necessary; something is not quite clear. The plans and specifications do not agree on some point. Which is right? There is no time to find out, the only person who can enlighten you is asleep, perhaps, while the careful estimator is burning the midnight oil, and wrestling with problems which can be avoided and entirely eliminated under a more modern system of estimating.

Again, the careful bidder who honestly tries to get in all the items, and figures to do the work as called for, is frequently beaten by a less competent bidder, who forgets something, or who, maybe, is willing to take a chance anyway, in order to get the job. True, omissions in lists of materials are sometimes unavoidable, under existing methods, which unfortunately aim at speed rather than accuracy.

It is, to say the least, disappointing to a careful bidder on a large job to find his bid just above the lowest, and after the low man has signed up the contract, it develops that the painting, or some such item, was left out. This, however, could not occur with the Quantity System.

This is no overdrawn picture, as I know from personal experience. The competent bidder who gets in all his items to-day is usually under a disadvantage, unless he happens to be figuring against men of his own stamp. Meanwhile, it would appear that the chances are in favor of the owner, most of the time, and it seems to be a case of "heads I win, tails you lose." Surely it is time there was a change.

The existence of present conditions, whilst much to be regretted, is due to a blind continuance of early-day custom. It is in no way up to date, nor conducive to progress, nor to that business success to which a bona fide contractor is entitled. It is entirely unsuited to modern construction and modern methods. The tallow candle, years ago, was a great invention, but how many of us would light our homes to-day by this method? And yet our estimating methods of to-day date from the same identical period as the tallow candle. Other countries have long ago graduated from such primitive methods, but we are content to stand still, and we are, in this respect, away behind the times. It seems to be almost inconceivable that shrewd business men are still willing to spend their time, all going over the same ground, figuring against each other on quantities, knowing all the time that they are all, save one (and sometimes even that one), simply wasting their time. By the adoption of some sensible system, all this quantity taking could be done by one competent person.

The great difference we find in bids arises, in my opinion, not so much in the prices or money values placed against the quantities, as it does from errors in the quantities themselves, the accurate preparation of which calls for special training and continuous concentration of mind, which the busy contractor of to-day can seldom find time to acquire.

Now we will investigate a bill of quantities, such as we are considering. What is it? and how is it used?

First of all, it is a document, handed free of expense to each bidder, lithographed or similarly duplicated, in order that all bidders' copies may be exactly alike. It will contain everything which it is essential for a contractor to know when making up a figure, with a separate section for each trade, such as excavation, concrete, brickwork, and so forth. A general summary is provided at the end of the bill, in which is entered the net cost of each trade; this summary is footed up, the profit the bidder expects to make is added, plus the cost of the quantities, the result being, of course, the amount of the bid.

The methods of measurement must conform to the standards used by each individual trade, and through the bill the greatest care is taken to have everything systematized; all cubic, square and lineal feet, and numbers of items, will be found all together under their respective heads. In this way, immediate reference may be made to any item required, even though the entire bill may contain hundreds of items, and so every item has its proper place—nothing is left to chance. Detail sketches also appear in the margins whenever necessary, to show a bidder at a glance what is required. These, as we know, are of more value to an estimator than the long written descriptions one sometimes finds in specifications. The keynote of the Quantity Surveyor is accuracy. In going through the drawings and specifications he has come across all those doubtful questions which always crop up when figuring under present methods. He will have taken them all up with the architect, and adjusted them, before the quantities are handed to bidders, so that everything is all plain sailing.

Keynote—Accuracy

Nothing is "near enough" for a Quantity Surveyor—he scrutinizes every part of the work closely, clears up any doubts, or anything capable of a double interpretation, and his work leaves no loopholes for either the owner, the contractor or the architect to take advantage of. The result is that it is seldom necessary for a bidder to ask questions of the architect when making up a figure. If he should wish to do so probably he would be referred to the surveyor, who is familiar with every minute detail of the work.

Further, and right here, lies one of the greatest advantages of the Quantity System. It is not necessary, except in a general way, for a bidder to study the drawings and specifications at all, and he certainly does not have to figure them. He simply prices the bill of quantities, and, in these days of hurry and bustle, this is as much as a contractor can be expected to do for nothing. This enables the competent contractor (the one who has unit prices at his finger ends) to make up a bid for, say a $100,000 building, in a few hours, and he has the satisfaction of knowing, when the unit price is placed against each item, that nothing has been forgotten; in other words, he only contracts to furnish so much material and labor—and surely this is absolutely right in principle. Good reasons exist why the general contractor should have faith in his own judgment and accustom himself to price items in every trade which goes to make up the building business. It is the only consistent method of estimating, for anyone who claims to be a general contractor. Experience has taught most competent men that it pays to do it. The mere getting together of figures from sub-bidders, and footing up the totals of the lowest, is not estimating at all. That is mere schoolboy work. However, I am led to believe that this is now the exception among general contractors in San Francisco rather than the rule. The ideal contractor is the one who makes up his own estimates, and not he who is dependent, for any reason, upon sub-contractors, who thus become the real estimators. If every general contractor would keep a prime-cost book of all trades, and quantities were supplied to him, he would soon be in a position to give a fairly close figure upon any sized structure, without first taking sub-bids, and this I suggest is the most consistent, satisfactory, and profitable method to pursue, when bidding upon work as a whole; but of course it requires care and experience.

Further, one of the greatest arguments in favor of letting contracts as a whole is, of course, the fact that a general contractor has the ability to figure all trades in his own office, and that he knows how to, and will supervise the work of sub-contractors, if any. If architects can be assured of this being done, it would be better for all concerned.

In general practice I believe the accuracy of the bill of quantities should be guaranteed. Such a document might well be made the basis of the contract, equally with the drawings and specifications; if this were done, the chief cause of disputes between owner and contractor would be removed.

This, I submit, is entirely logical and right—a certain quantity of work for a certain sum of money, the owner to determine the former and the contractor to fix the latter. Surely this is morally just and fair.

Educating the Surveyor

It may be asked, Where are these competent surveyors to be found? And it would be a natural inquiry, as it is no part of the duty of architects to prepare such quantities. In fact, the relation of the architect to the contractor should preclude him from having anything to do with furnishing quantities. This should be attended to by a disinterested specialist—the quantity surveyor. In older countries, young men of education are now apprenticed to practising surveyors, and it has become a recognized profession. Years ago these quantity surveyors frequently came from the ranks of the architects; others possessing the necessary education were possibly contractors, building superintendents or estimators. I have known contractors' representatives who commenced life in the workshop, who, after securing the advantages of special training, made experienced and very competent quantity surveyors. There must be a beginning to everything, and doubtless there are many men in this country who, after some little training in the technique of this work, should make reliable quantity surveyors. The principal qualifications are honesty of purpose and a knowledge of architecture and construction. The surveyor should be a neat draughtsman and have actual experience in conducting building operations. He should possess the ability to readily detect discrepancies or conditions which might give rise to misunderstanding during construction, and last, but not least, the necessary mentality to act disinterestedly He must do what is right in measuring, as between the contractor and the owner. The usual custom is for the architect to furnish the quantity surveyor with a set of the drawings and a draft specification, and the latter then commences work in his own offices. During this period the architect and surveyor are in frequent consultation, to the end that all uncertainties are cleared up and adjusted upon the drawings and specifications. In short, no effort is spared to obtain clearness and accuracy before bidders commence figuring.

Such uncertainties are bound to crop up; they are unavoidable. They nevertheless perplex the contractor when he is figuring, and his foreman on the job, and create unnecessary trouble and sometimes bitter disputes; and then, in such cases, one of the parties to the contract is usually a loser.

Bill of Quantities

Now that we have briefly considered the qualifications of a quantity surveyor, let us take note of what the preparation of a bill of quantities involves. It may well be said that during the last forty years it has been brought to a mathematical science, and yet it is really surprising what a vague idea exists concerning the methods, objects and uses of the Quantity System. The fact remains, however, that where the system has been adopted, responsible contractors refuse to figure without it. Some day that will be the attitude of contractors in this country—when they fully realize the folly of wasting their time and money in competing against each other on quantities as well as on prices.

But to return: Three distinct processes are involved, and each process calls for different operations.

First—"Taking off" and entering every item (or "dimension," as it is called) upon the dimension sheets. This is always done in exactly the same order, in every building; no dimension, however small, is omitted—no guess-work of any kind is permitted. The exact location in the building of every dimension taken is carefully noted, and every figure or note taken is carefully preserved for future reference.

It is impossible to illustrate here the work in detail involved in taking off each trade, but the following may serve to show the general idea: Let us follow a surveyor for a moment in taking off his dimensions for a few items of—we will say common brick work. He always commences taking dimensions at the same point on each floor plan; every length of wall from one angle to the next is measured separately and the dimensions entered in "waste," as it is termed. We will assume that it takes, say, fourteen dimensions, and their locations are permanently recorded, footed up, and the total lineal feet is then placed immediately below this, and a line drawn across the column to separate it from the next item. The dimension is squared, i. e., the number of square feet these figures represent is figured out, and opposite to the total we find a description, thus, for example: 21-inch wall of standard common brick work laid up with lime, mortar and Portland cement, gauged three to one, pointed with flat joints one side for whitewash and raked out the other side for cementing.

In good practice it might be best to give the number of square feet superficial of wall, and give the thickness. The same method is adopted with each storey, with its varying thicknesses of walls, every dimension being entered in precisely the same order, with its particular location noted.

Then we come to deduction of openings. Those with inside and outside reveals (as in the case of box-frame windows) are taken separately, door openings the same. Those of one size and one thickness of wall are "timesed," as we say, and entered in the dimension column, so; "Ddt. 9/3 feet 9 inches x 7 feet 13 inch outside wall, fifth floor."

Then should follow an item, "extra labor," to so many 8-inch common brick segment arches in, say, three half-brick row-locks to 4-foot 6-inch openings with 3-inch rise in 8-inch wall, include for cutting skewbacks, etc., and for woodturning piece and setting and striking. In case richer mortar was specified for arches, it would be so stated, and the proportions.

When rough cutting to brick work is required, every square foot of it would be measured. Brick work in footings or foundations, or walls below ground or at unusual heights, should be all segregated and given separately, with full descriptions.

Such items as the following are then taken by the square yard or square foot—viz., selected common brick facing. If joints are struck and cut (as face work), it is taken as a separate item, as should be the case with any portions that are to be pointed with special or colored mortar. Cementing by the square yard if on ordinary plain surfaces, but if in widths of 12 inches or under, then this is separated and taken by lineal foot; should this work occur on circular surfaces, it would be so described, kept separate, and the radius given. Lineal dimensions are taken of all rough splays and chamfers, flues, pointing to flashings, projecting courses, with the number of mitres, splays, or stops in same; brick sills, with the returns, are numbered, if any. The labor of forming quoins, square or splayed, and (in certain cases) the lineal feet of plumbing angles and reveals, might be taken, also leveling up for joists, bond iron and the like.

The foregoing applies to common brick work, as before stated. Now, where "face" brick are used, the entire surface of such facing is measured by the square foot, including reveals and soffits (but openings deducted), the kind of mortar and the labor of pointing being given. Here would be taken such items as face arches. Fair cutting by the square foot on same principle as mentioned for common brick work. Then come lineal feet of each course, of which figured sketches should appear. Raking mouldings or belts separate; then follow the number of external, internal, raking, skew or other mitres; also square ends, etc. (if any). All other lineal feet items follow in their proper order, and then in a similar way, concluding with numbered items, which would be described and (if necessary) sketched in the margin. I am aware that this is but a very elementary illustration of the detailed method of taking off, but the principle applies throughout every department, in every trade, from the excavator to the painter, but it would be too great an undertaking to go fully into details here in each case.

Surveyors' quantities are usually measured net, and it is so stated in the preamble of the bill—upon the understanding that the unit price for each item is to be made, by the contractor, to cover trade customs, etc., which differ in each locality.

The before-mentioned dimension sheets are usually checked over with the drawings by a second person, and then all totals are abstracted; that is to say, they are transferred to abstract sheets, under separate headings. In this way many similar items of the same value are collected together and footed up and checked. This reduces the number of items which appear eventually in the finished bill, which is written direct from those abstract sheets, and any further sketches or descriptions necessary for the bidder to thoroughly understand what is required are then finally added. When completed, a sufficient number of copies of these bills are lithographed, or otherwise duplicated, and a copy is sent by the surveyor to the list of prospective bidders, whose names and addresses have been previously furnished him by the architect.

Advantages of Quantity System

Some of the advantages of the Quantity System of estimating to the contractor are as follows:

1. Saving of time and money.
2. Greater precision in measuring.
3. No uncertainty as to interpretation of plans or specifications (the quantities should govern).
4. No visits to the architect's office when figuring, for explanations or otherwise.
5. No other work is contracted for except the quantity set forth in the quantities.
6. The contractor, if he so desires, can check up the quantities before signing the contract. In an American system of estimating, the quantities should, I think, form part of the contract.
7. No bidder can inadvertently leave out anything, and so in this way arrive at too low a figure.
8. Not having to spend time taking out his quantities, the contractor has time to attend to more profitable business.
9. Systematically arranged bills of quantities duly priced (whether work has been secured or not) form excellent data for making future estimates.

Semi-rapid Transit Scheme for Toronto

(Concluded)

demands, and the City extends, provide for the operation of semi-rapid transit lines to serve outlying districts.

Rapid Transit Lines

1. The streets in the central area are sufficient to care for future traction and vehicular demands, provided reasonable regulations are enacted, and enforced, governing vehicular and pedestrian traffic.

2. Traffic may be much facilitated by an increase in speed of the existing Toronto Railway units. This entails improved equipment, track, routing and operation, together with the adoption of up-to-date loading and unloading facilities, and the much needed education of the public to embark and debark speedily. The accomplishment of this, together with adequate extension of surface lines, will make it possible to travel from the centre of the present city limits within a thirty-five minute period.

We have been assisted to the foregoing conclusions by the study of Drawings, Nos. 8 to 15 inclusive, showing present volume of traffic with origin and destination, lines of heaviest movement, and street traffic counts.

3. In relation to the matter of change of gauge, notwithstanding that almost every economic consideration declares against it, the dominant factor is that of future traffic unification, between radial, semi-rapid, and city surface lines, and this is impossible without the reduction of the present gauge from four feet ten and seven eighths to four feet eight and one-half inches.

4. As hereinbefore indicated, there is no justification whatever for the construction, in the City of Toronto, of a rapid transit system in the strict sense of the term.

The Confederation Construction Company, contractors on Section 3, Welland Ship Canal, have placed an order with M. Beatty & Sons, Limited, Welland, Ont., for six electric hoists. Two of these are 50 h.p. with single drums, two 50 h.p. with double drums, and two 35 h.p. with double drums. All are to be used on the new concrete handling plant which the construction company are building this winter for use on the Twin Flight Locks next spring.

The Toronto-to-Hamilton Highway

Forty-mile concrete roadway well advanced—Advantages seen in increased land values and heavier and more frequent traffic

Now that the construction work of the Toronto-Hamilton Highway Commission is closed down for the present season a brief description of what has been accomplished during the past summer will be interesting. The total distance is approximately forty miles, as shown in the map herewith. Of this total distance approximately seventeen is completed, and the grading is done on most of the remaining twenty-three miles. Some delay has been caused near both the Toronto and Hamilton terminals on account of the difficulty of coming to an agreement with the municipalities concerned on the best location of the roadway. It will be remembered that this work was undertaken very largely to relieve the labor situation which existed at the time the project was first outlined, and naturally the plans were not as complete and definitely outlined as would otherwise have been the case. There is still to be determined the gradient at which the road will

Fig. 1.—Expansion joints are placed every 35 ft.

enter the city of Hamilton; also the exact location through the municipalities lying immediately west of Toronto. If these matters can be decided upon in time for spring work it is stated that there should be nothing to prevent the completion of this highway in a few weeks—say, three months at the latest.

Considering that a very large amount of extra work had to be done that was not covered in the original estimates, splendid progress has been made with the roadway to date. As an example of this extra work it may be mentioned that the culverts along the way, which were at first reported to be in a fair state of repair, were later found to be unsatisfactory, and had to be replaced by permanent structures. A considerable amount of extra work has also been done in the towns and villages through which the roadway passes, as, for example, in Oakville, where the roadway is widened from eighteen to fifty feet along the main street. The same is true to a smaller extent in other municipalities through which the roadway leads.

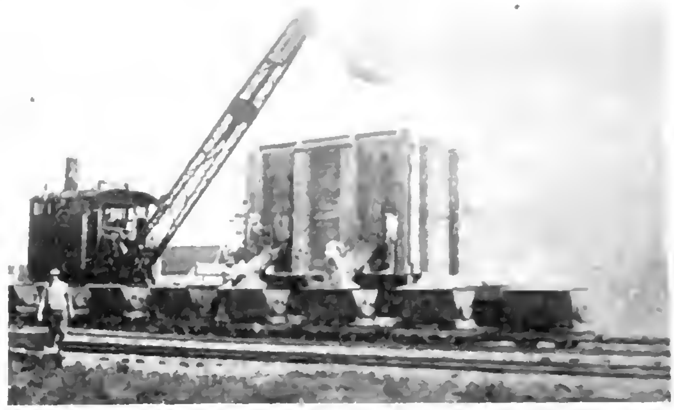


Fig. 2.—Time was saved in handling material.

That this work has been prosecuted with considerable vigor is indicated by the fact that six mixing gangs were employed, one of which on a certain occasion made a record of 630 lineal feet of 18-ft. roadway in a twelve-hour day. The average ran about 420 feet a day of ten hours for each gang; so that the six gangs could be depended upon to do a mile about every two days under favorable working conditions.

A section drawing of the roadway is shown in Fig. 3 herewith. The road is first graded 26 ft. wide, perfectly level, with a ditch on each side, the depth of the ditch depending, of course, on the road grade. The concrete roadway in general is 18 ft. wide, leaving a 4 ft. strip at each side between the concrete and the ditch. This strip is, for the most part, filled in with such earth as happens to be most easily available. It was the original intention to macadamize these strips, but the extra cost did not appear to be offset by sufficient added advantages. This earth-fill does not in general extend to the very edge, a narrow berm of some six inches being left to prevent the earth from falling into the ditch. The concrete material is six inches deep at the edges, grading up uniformly to $8\frac{1}{4}$ inches depth at the centre of the roadway. Composition of concrete is $1:1\frac{1}{2}:3$.

The photograph herewith illustrates a number of interesting phases of the construction operations. The mixers used were the Austin Cube machines, half yard capacity, one of which is shown in Fig. 7. This mach-

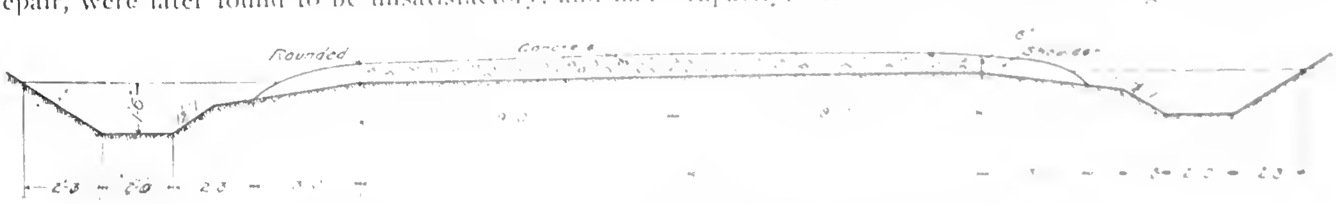


Fig. 3.—Section of Toronto-Hamilton concrete roadway—26 ft. overall, width of concrete 18 ft.

Fig. 4.—Divided float in use at expansion joint.

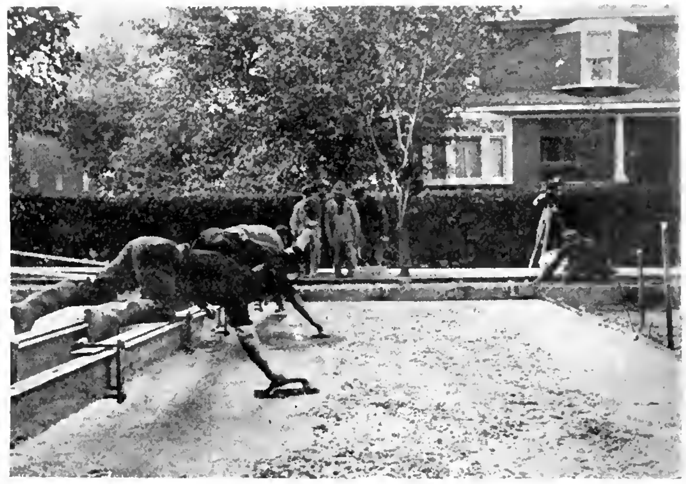


Fig. 5.—Bridge from which men complete the "floating."

ine is supplied with a 20-ft. trackway, along which the bucket carrying the concrete mix runs, and which can be operated through a wide angle. This arrangement allows of a very even distribution of the concrete over the roadway. Fig. 7 shows the men levelling the concrete, after which the proper grade is given to it with a template or strikeboard, also shown. Fig. 4 shows the condition in which the roadway is left by this strikeboard. It is later smoothed over by hand-floats, as shown in the same figure.

Fig. 4 also shows one of the expansion joints. These joints are placed every 35 feet. A better view is shown in Fig. 1. The expansion joints are approximately ¼ in. thick. When the roadway is completed they are trimmed off evenly with the surface with a sharp spade or other suitable tool.

Fig. 4 also shows a quantity of newly poured concrete roadway covered with tarpaulin to prevent drying out during the early stages of the setting process. The practice followed throughout was to cover with tarpaulin as soon as completed and leave for a few hours. The tarpaulin was then removed and replaced by about two inches of earth, which was kept damp during the first ten days and finally removed after twenty-one days, when the roadway was opened for public traffic.

One of the difficulties in placing the concrete in successive sections in a roadway of this sort is in preserving a uniform level on both sides of the expansion joint. On the Toronto-Hamilton highway this is accomplished by the use of a divided tamp, which is followed up by a divided float. One of these tamps is shown lying on the ground on the lower left-hand corner of Fig. 1, and the divided float is shown in operation in Fig. 4. In this way a perfectly even surface is obtained, so that there is no jolt to a vehicle passing from one section to another.

Another interesting feature of this work is the travelling platform on which the "floaters" work, no workmen being allowed to place a foot on the roadway after the floating operation has been completed. This platform or bridge is shown in operation in Fig. 5, which is a view of the 50-ft. roadway being placed along the main street of Oakville. The bridge moves along on rollers placed at each end just outside the curb.

Fig. 2 is an interesting view indicating how time was saved in handling material. The box-like structure is mounted on a flat car, and kept filled with crushed stone, either from a stock supply as shown in the figure, or direct from railway cars as brought in. It will be seen that the dump-cars are being filled two at a time from two chutes which supply material from

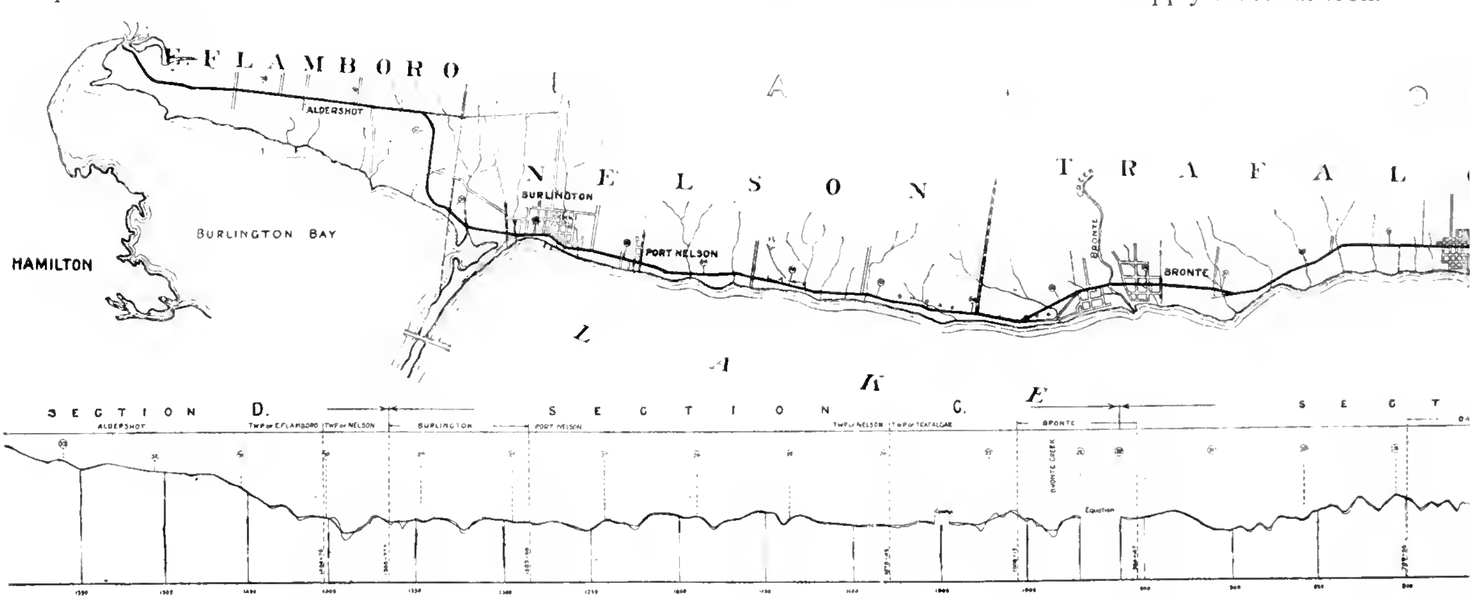


Fig. 6.—Plan of concrete roadway which will connect Toronto and Hamilton through one of the most attractive scenic districts in the prov

Fig. 7.—Mixing and distributing machine.

Fig 8.—Scarifier operated by Traction Engine.

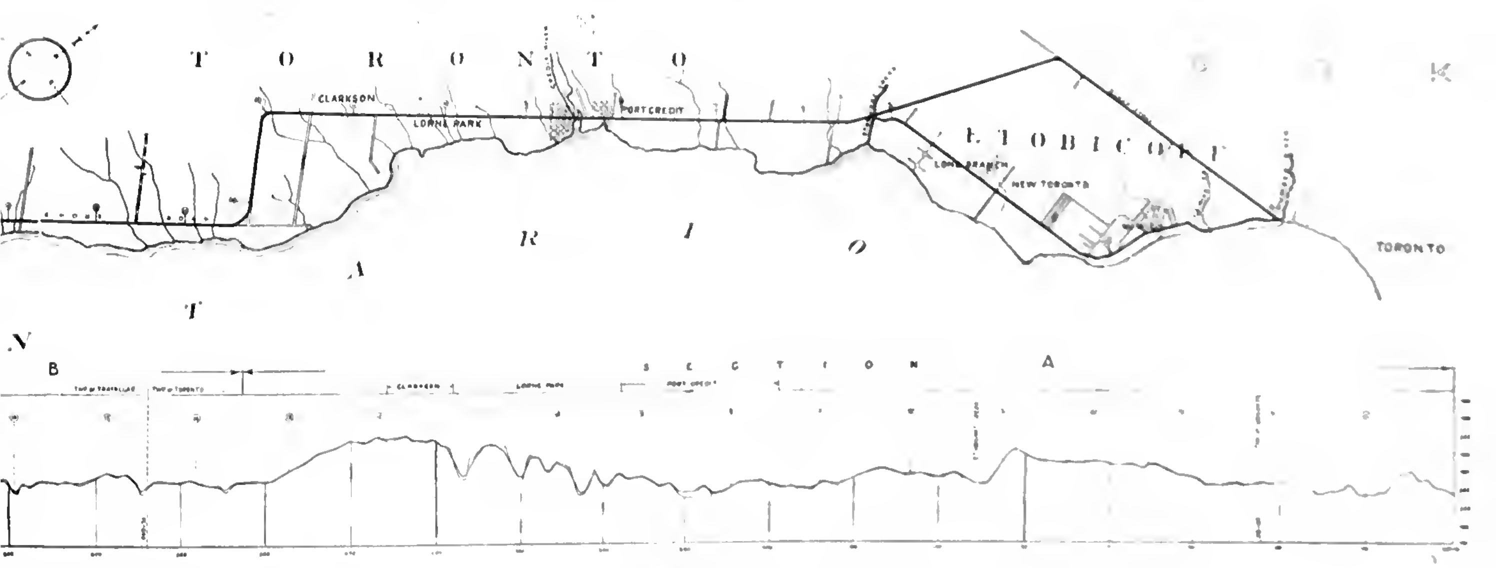
the large bins. In this way a trainload of dump-cars is loaded in less than half the time required to do this work by bucket and hoist, and the transportation capacity of this train is correspondingly increased.

Materials Supplied

The paving machines used are the Austin Cube type, purchased from Lecky & Collis; the crane used was supplied by the Brown Hoist Company, of Cleveland; dumping cars were supplied by the Dominion Wheel and Foundries Company, Toronto; the engine which operates the dump cars was purchased from the Canadian H. K. Porter Company, of Chicago, through the Construction Supply Company; the wheelbarrows used are the Meaford type, purchased through Wood, Vallance & Company; pumps for supplying water along the road are the Triplex type, manufactured by Smart, Turner & Company, purchased through A. R. Williams; the gasoline engines used on the pumps, Niagara Brand Spray Company, Burlington; scarifiers employed are the Austin type, Chicago, purchased through Mussens Limited; Rogers and Canada cement are both used for concreting; wire reinforcements were supplied by the Standard Tube and Fence Company, Woodstock; crushed stone by Rogers Supply Company; expansion joints by Bird & Son, Hamilton; tools used were bought from jobbers in general, or made by the Commission.

Profitable Year for Dominion Bridge Co.

The large earnings on shell orders are reflected in the annual report of the Dominion Bridge Company for the year ended 31st October. The net profits totalled $1,344,347, an increase of $714,379, and the largest recorded. These are after writing down depreciation on plant and machinery. After distributing 8¾ per cent. in dividends and bonus, a total of $568,750, paying $13,910 in directors' fees, transferring $204,282 to reserves, and applying $174,580 to writing down the company's holdings of National Bridge stock to a nominal value of $1, a balance of $382,817 remained to be added to profit and loss account. Mr. Phelps Johnson, the president, states that the company have a controlling interest in the Montreal Ammunition Company and the Dominion Copper Products Company. The bridge and structural business was much better than was anticipated, the volume of this business entered the past year being 86 per cent. of the business entered during the preceding year. Much of this business was secured at good prices, as the company was in a position to give ex-



more than half completed—Many heavy grades reduced so that maximum is 4 per cent.—Six gangs building this road at rate of half mile a day ceptional deliveries to those requiring plants built quickly for war business. The large profits were due chiefly to the fact that "a number of large contracts which had been in progress for several years were fully completed and charged up during the year, and because an exceptionally large proportion of the business written was completed during the year, and the profits accruing therefrom taken promptly into the accounts. There is a marked revival in the demand for structural work, and it is anticipated that your shops at Lachine, Toronto and Winnipeg will be kept reasonably busy and at satisfactory prices.

"Construction on the Quebec bridge, in which contract your company has a half interest, has progressed favorably during the year. The north cantilever arm is now completely erected and the traveller is being taken down to be used for the erection of the centre span. The south anchor arm is also completely erected and is further advanced than was the north anchor arm at a corresponding period last year. Unless the present shortage of steel delays the manufacture of the centre span, or the Government should curtail appropriations for progress estimates, it is anticipated the steel work will be fully erected next season."

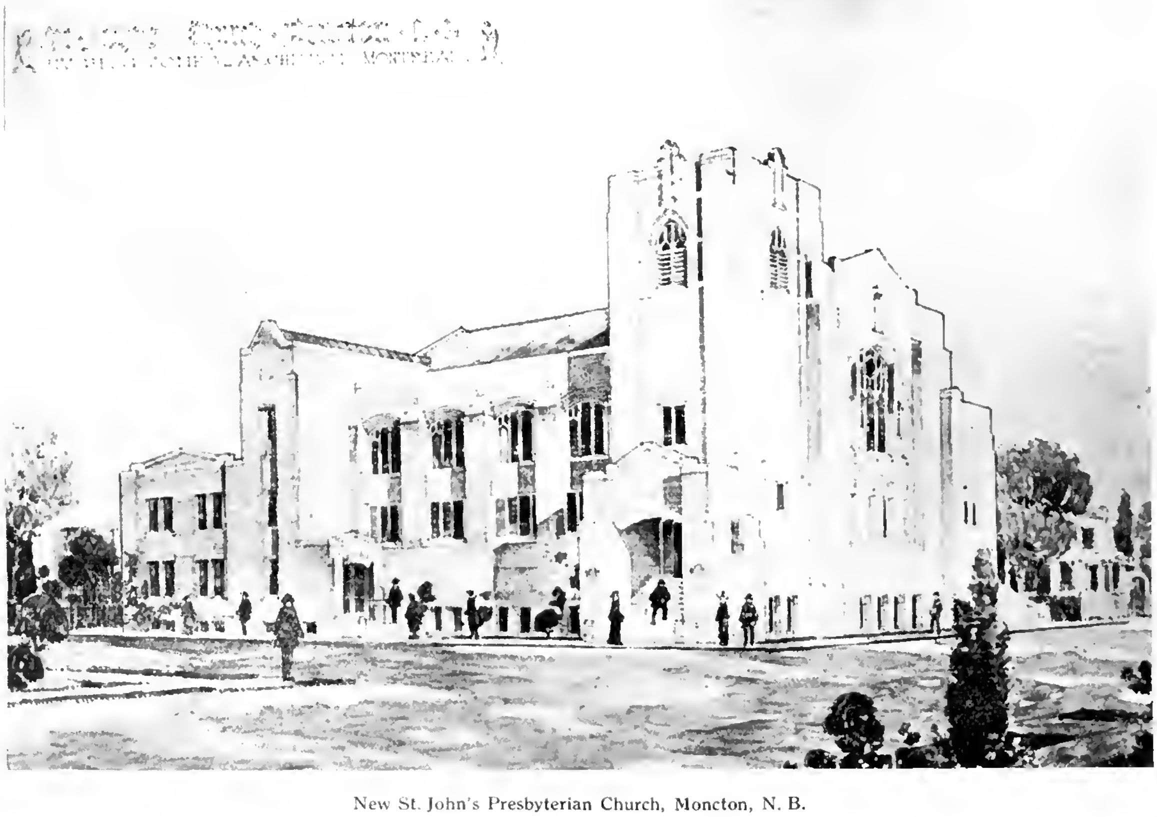
The company has opened a London office and endeavored to secure new foreign business. One contract had been executed for Madras, India.

Handsome New Church for Moncton, N. B.

The latest addition to Moncton, N.B., church buildings is the St. John's Presbyterian Church, erected at the corner of Alma and Victoria Streets. The design of the building was in the hands of Mr. Hugh G. Jones, architect, of Montreal, and the work was carried out under his supervision.

The exterior walls are of Wallace brick and Newcastle stone trimmings. The building is heated by a low pressure heating system, the air being exhausted by a blower connected by ducts to the front of the pulpit platform. The lighting is electric with semi-indirect fixtures. Seating accommodation is provided in the auditorium for 1,000 people, while a Sunday School at the rear provides accommodation for 500. A large assembly room has a seating capacity of 900, with a stage at one end and men's and women's retiring rooms adjoining. This hall is admirably suited for the social needs of the church.

The interior decoration and furniture was made from designs prepared by Mr. Jones. The total cost of the building was $80,000. E. B. Evans & Company, Montreal, were the general contractors, and the following firms had sub-contracts: Roofing and sheet metal, Sumner & Co., Moncton; plumbing and heating, F. J. Friedman, Montreal; millwork, Rhodes, Curry Co., Amherst, N. S.; plastering, A. W. Calkins, Moncton; painting, A. E. Metzler, Moncton; electric work, Perry Bros., Moncton; hardware, Lariviere, Incorporee, Montreal; stained glass, J. C. Spence & Sons, Montreal; organ, Canadian Pipe Organ Co., Ltd., St. Hyacinthe, Que.; seating and furniture, Berlin Interior Hardwood Co., Ltd., Berlin, Ont.

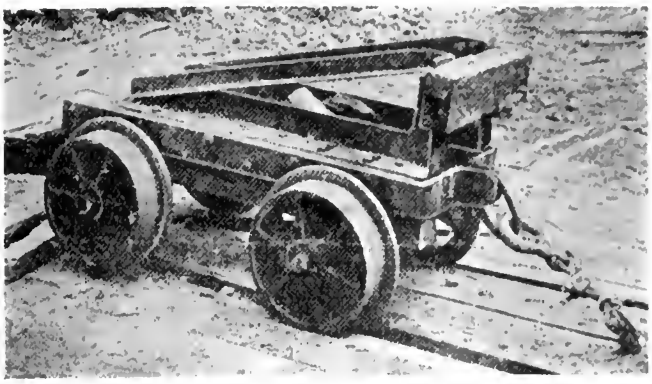


New St. John's Presbyterian Church, Moncton, N. B.

Barney Car for Hauling Wagons Out of Pit

The view shows a Barney car for hauling dirt wagons up to street level. The use of this car enables wagons to take a full load, and avoids the use of a snatch team.

The car runs on a narrow-gauge track of light rails laid on the incline. The nose of the car comes above the level of the rear axle of the wagon and thus when placed behind the axle pushes the wagon up the slope. A cable from the front of the car goes up the incline



Heavily built Barney Car for hauling wagons out of a pit.

to a snatch block near the top, where it passes through the decking and laterally downward to a hoisting engine. The car, as will be noted in the figure, is quite heavily made, and the butting block is well braced back to the main frame.

Toronto's Pavement Work Slightly Reduced

The following table shows the quantities of the various classes of pavement laid in the city of Toronto during the past year; also for comparative purposes the figures for 1914:

	1914		1915	
		Square		Square
Class of Pavement.	Lin. ft.	Yards.	Lin. ft.	Yards.
Asphalt..	98,032.3	315,594.0	85,262.6	275,661.9
Bitulithic	14,498.3	43,758.0	15,754.9	50,433.0
Concrete..	15,774.9	26,348.0	14,902.4	20,768.9
Brick Block	4,054.2	11,465.0	8,127.4	26,629.8
Asphalt Block.... ..	....	....	....	....
Macadam	....	....	....	....
Asphalt Macadam ..	1,112.0	3,485.0	....	....
Const. new T. A...	5,058.5	7,252.9	6,730.0	13,518.0
Recon. T. A.	18,172.9	33,710.3	23,720.0	47,440.0
Grading	47,769.0	....	10,483.7	....
Granite Block	....	....	....	....
Treated Wood Block	1,443.0	2,440.0	297.7	5,513.6
Tarvia Macadam ..	....	....	....	....
Rocmac Macadam ..	7,067.1	24,406.0	5,406.8	14,790.3
Dolarway	....	....	....	....
Asphaltic Concrete .	13,700.4	48,516.0	2,852.5	7,856.1
Totals	226,682.6	516,975.2	173,538.0	462,611.6

Building Activity in Sherbrooke, P.Q.

A report just issued from the building inspector's office in the city of Sherbrooke, Que., indicates that during the year 1915 forty-three building permits were issued, amounting to a total value of $350,000. Considering the depression generally felt in all trades during the past year, it is gratifying to note that building operations in this city were sufficiently active to keep all classes of labor well employed. That this was the case is indicated in the report. It is further stated that the outlook for the year 1916 is very encouraging, as buildings to the value of $250,000 are already contemplated. Adding to this the amount of construction work which is usually done during the year, the report concludes that there will be ample employment for all classes of labor.

Good Progress on St. Maurice River Dam

Work on the St. Maurice River dam being constructed for the Quebec Streams Commission by the St. Maurice Construction Company (contract sub-let to Fraser, Brace and Company), has made excellent progress. The site of the dam is many miles from the railway, and the contractors intend to use the river for thirty miles for the conveyance of supplies, machinery, etc., and a standard gauge line for the remaining twenty miles. About one and a half miles of this line has been constructed, and engines have been run on it. A very large quantity of ties have been cut; the timber on the whole right-of-way has been cleared; a large amount of crib work done; a complete telephone system installed; several log camps built; and terminal facilities at Manouan crossing completed. At one time the contractors had 500 men on the job.

Printing Error

In our last issue, in quoting materials used in the construction of the track platform, Yonge Street Grade Separation, we stated that 200,000 cu. yds. of reinforced concrete were used in the track slabs; this should have read 2,000 cu. yds.

Development of Canadian Highways

(Concluded from page 6)

tially macadamize the leading market roads in less than ten years.

National Progress and Production

I have journeyed in Northern Canada, along trails which, in fur trade, have been used by the Indians for centuries. A little work in removing fallen trees, in levelling knolls, filling low places, or improving the canoe landing, would have made the portage infinitely less laborious. But year after year the Indian has travelled these routes in shiftless abandonment to the obstacles imposed by Nature. As we regard the improvidence of the Indian with respect to his trails, so those who are accustomed to the splendid highways of Great Britain and France look upon the neglected and unimproved roads of this continent. They consider that only a very wealthy country, improvident of its resources, can progress under the handicap of bad roads. Those who have bad roads consider good roads an expensive luxury. But those who have seen the advantage of good roads, know that good roads are a necessity.

Standard Clay Products Calendar

Standard Clay Products, Limited, of St. Johns, P. Q., and New Glasgow, N. S., are distributing a very useful 1916 calendar, mounted on a background which illustrates various phases of their constructional operations and products. The sewer pipe plant of this company is claimed to be the largest in Canada.

Separate Manholes for Different Companies

The Quebec Public Utilities Commission, with the Dominion Railway Commission, sitting in Montreal on December 20, heard further arguments on the question of providing separate manholes for signal companies and for lighting and power companies in the underground conduits being constructed by the Electrical Commission. This is the first time that the Railway Commissioners have sat jointly with the Quebec Public Utilities Commissioners, the reason for this innovation being that as some of the companies affected hold Dominion charters, the question of jurisdiction may not be raised later in the courts. The Electrical Commissioners asked for sanction of plans for sections 6 and 7 in the business sections.

The Montreal Public Service Corporation, Bell Telephone, G. N. W. and C. P. R. telegraph companies, and others, asked that separate manholes be constructed, contending that there was danger of damage where only one manhole was made; on the other hand, the Electrical Commissioners argued that the present system was safe and that the danger was exaggerated.

Professor L. Herdt, chairman of the Electrical Commission, expressed the opinion that the best protection for the cables was to protect the cables themselves.

Sir Henry Drayton asked Professor Herdt if he had ever known a system of insulation that did not break down. The answer was "No." The chairman responded that if they had not an insulation that would not break down they could not say it was safe to put high potential wires near low potential wires. If the Electrical Commission were willing, however, to take the responsibility for any accident, he did not see why they should not be given an opportunity.

The question also arose as to the provisions of the provincial statute governing the construction of conduits. It was argued that the statute required double conduits, and Prof. Herdt retorted to this that the requirements of the statute were "absolutely obsolete to-day."

The joint commissions ordered their engineers to meet the engineers of the different companies affected and examine their plans. If the terms of the provincial statute needed amendment for safety, application could be made to the Legislature for that purpose.

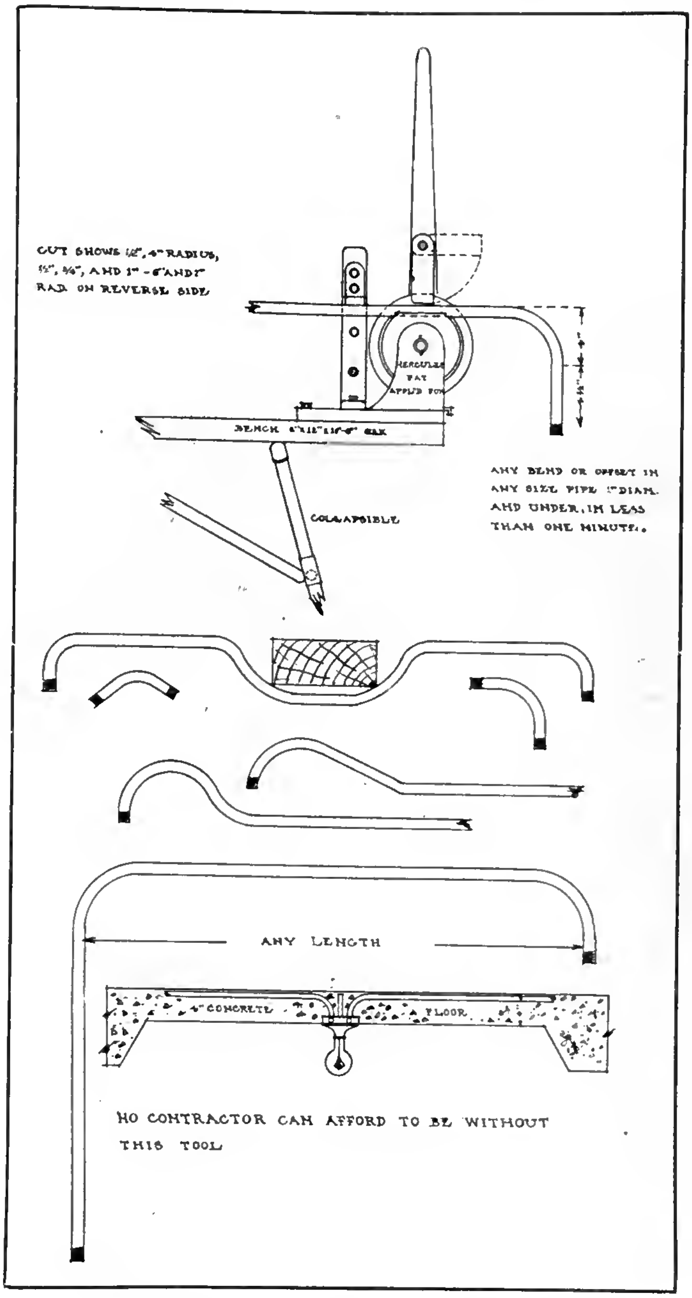
Efficient Pipe Bender

We illustrate herewith a new pipe bending device invented by Mr. G. E. Phillips, of the MacKenzie Electric Company, engineers and electricians, Sarnia, Ont. The basic principle on which this bender works is that the pipe is pulled around a grooved form, of the radius required, and not forced into shape with wheels or cams. The machine is very simple in construction and arranged to take the pipe from the side, which can be inserted or removed in an instant. With this bender it is possible to make a number of bends on one piece of pipe—bends and offsets being absolutely perfect.

The inventor claims a very considerable saving by the use of this equipment. On one job alone, which required all bends to be 4 inches radius, it saved 35 per cent. of the time and paid for itself just twice over. On any job where the contractor's time runs to as much as $150 the price of the machine can be saved in time gained. There is no guess-work about it. Pipes up to 1 inch can be bent cold and single groove machines for work up to 2½ inches will also be covered by this line, but the pipe will have to be heated before placing in the groove. This, however, will give a perfect bend without any flats or kinks whatever.

The proper way to rig up one of these machines is to have a 12 foot 2 inch plank 12 inches wide on a collapsible pipe frame. Put the bender on one end and the pipe vise on the other. The supply of conduit to be worked goes on the cross-bars of the frame under the bench. This helps to keep the bench down steady and the material is within reach. One-half inch to 1 inch bender weighs 75 pounds and, of course, cannot be used otherwise than on a plank.

If the saving on small jobs is so considerable it may easily be seen how efficient this machine would be on a job such as, for example, the new Union Station, where the amount of bending required is so considerable. Two or three of these machines would save hundreds of dollars in time and in addition every bend and offset would be perfect.



New pipe bending device—the invention of G. E. Phillips, Sarnia, Ont.

The Martin-Senour Company, Limited, Montreal, held a sales convention from December 13 to 16. The sessions were held at the Place Viger Hotel and at the paint and varnish factories, the delegates being welcomed by Mr. W. H. Gerke, the general manager. The subjects discussed related to advertising, salesmanship, agencies, price lists, policy, etc. On December 15 the usual "family dinner" was held at the Canada Club.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

Every day brings fresh evidence that the viewpoint of the Contract Record on certain vital questions that have been touched upon in previous issues under this heading coincides with the sentiments of thinking business men. It is further gratifying to note that even the Conservative papers throughout the Dominion are demanding an investigation into conditions surrounding various munitions contracts.

* * *

> The German prisoners of war at Montreal refused 400 pounds of turkey purchased for their Christmas dinner, ordered it taken away, and sent for a load of geese instead.—Exchange.

And I suppose the goose was served them. What a lot of simpletons we Britishers are. Given my way I would have served them lead in place of turkey.

* * *

We shall never sheathe the sword until Belgium recovers in full measure all, and more than all, that she has sacrificed, until France is adequately secured against the menace of aggression, until the rights of the smaller nationalities of Europe are placed upon an unassailable foundation, and until the military domination of Prussia is wholly and finally destroyed.—Premier Asquith.

* * *

The Minister of Finance hints at another War Loan of \$300,000,000. Bring it along, Mr. Minister. The Canadians will take care of it provided it is for the benefit of the Empire. In the words of the song—

"We didn't want to fight, but by Jingo! now we do
We've got the men, we've got the guns, and got the money too."

* * *

Major-General Bertram has taken all the alleged sins of the Shell Committee on his shoulders and gone south in search of new health. On his way he passed through Toronto, where he was able to sit up and talk about a column and a half to The Globe. Possibly he figured that giving his side of the story publicity through the Liberal organ would leave it free from partisan flavor and give the people of Canada an unprejudiced view of a great patriot who has been misunderstood and misrepresented. Anyway, he, by his own announcement, stands before you a man who rose from mechanic to manufacturer; who offered his services to his country and was made chairman of the Shell Committee. He awarded all the contracts, and was responsible for the Committee in every way. He alone awarded contracts to the amount of \$345,000,000, and doing it made a saving to the British War Office of \$42,000,000. And after doing all this he has been criticized! Do you wonder that he picks out a Grit newspaper and cries through its columns, "The attacks are not fair. They are breaking my heart."

* * *

Surely Sir Robert Borden will not allow that great heart to break. He has been loyal to his country, to his King, and to Sir Sam Hughes. For does he not quote Sir Sam's instructions "No politics—no graft"? And do we not know out of his own mouth that he made them his watchword and reply? And yet his hard-hearted leader sits idly by while leading Conservative papers like the Ottawa Journal, the Hamilton Spectator, and the Montreal Mail clamor for explanations. Surely the Premier should be able to see that a thorough investigation into the workings of General Bertram's committee would not only clear that gallant officer of the attacks that are breaking his heart, but would also prove once and for all that Canada is not and never has been the home of the profiteer. For to Canada's mind, as well as to the mind of the chairman of the Steel Company of Scotland, "there is something absolutely revolting in the idea of anybody actually making profits out of the nation's agony."

* * *

And though General Bertram may be staggering south with the entire weight of the Shell Committee on his shoulders, it is to Sir Robert Borden and his Government that the public look for explanations. The Government appointed the Shell Committee, and even if it acted in behalf of the Imperial authorities and took its instructions from them it represented the Canadian Government in every transaction in which it took part. It was the servant or agent of the Canadian Government and to its employer we must look for explanation of its actions.

* * *

So far Sir Robert Borden has taken no action in regard to the matter. He was heard from once in regard to the F. P. Jones incident, or chapter of incidents. His Government has appointed Sir Charles Davidson as official investigator of war contracts, but apparently his powers only extend to contracts for materials to be paid for out of the Dominion treasury. The order in council appointing the Commission reads "concerning the purchase by and on behalf of Your Royal Highness's Government." Consequently it would appear that as the shells were purchased for the Imperial authorities the shell contracts do not come within the scope of Sir Charles Davidson's labors. If this interpretation is correct the Government is all the more to blame for its silence. It was supposed that Sir Charles, with his investigations of spavined horses and poulticed drug bills, was simply clearing the decks for the heavier work. Now we are left to believe that with the "war baby" lying in its unnamed grave, General Bertram hurrying south with his failing health and breaking heart, and Wall Street boosting stocks by reports of enormous war profits, no provision has been made for clearing the matter up in any way whatsoever.

* * *

What use, then, to talk about taxing war profits? Without an investigation how are we to know that there are any profits to tax? General Bertram claims that he got the shells made for \$42,000,000 less than the estimates of the British War Office. Can it be possible that his one sin was too much economy, and that the impoverished contractors are really entitled to allowances from the Patriotic Fund? Was the man who had a half a million to spend on a plant with which he offered to make shells at cost really asking more than contract prices? Are all those stories that come from Wall Street simply attempts to sell a little stock to tide over a losing season spent making munitions? If any or all of this is true surely others besides General Bertram are entitled to the credit that only an investigation can bring.

* * *

But on the other hand, if the charges mentioned by the Montreal Mail have foundation it is the public and not the committee or contractors who are entitled to explanations. The Mail in criticizing General Bertram's open letter to Sir Sam Hughes says in part "It is with real reluctance that the Daily Mail suggests the incompleteness of what is termed General Bertram's 'valedictory.' A public duty, however, cannot be evaded, and it is a public duty to remind General Bertram that his statement, utterly lacking in detail and definiteness as affecting the criticism of the work of his committee, does not allay suspicion but tends to strengthen it. Major-General Bertram has been accused of enriching his private interests from business placed by the Shell Committee under his direction. He has been accused of showing favoritism in the distribution of shell orders, and of allowing prices to the manufacturers (including his own concerns) out of all proportion to the cost. Not one of these charges did he deal with in his valedictory, except in relation to the price of shells, and in this particular matter he withholds from the public the very information it desires." These are warm words. They are all the warmer that they come from a Conservative paper edited by M. E. Nicholls, a half-brother of Hon. W. T. White, Minister of Finance. It might be added, however, that in a more recent statement General Bertram states that he has only one share in the John Bertram and Sons Company, Dundas, Ont., which was the first firm to ship to England, and that he has never drawn a dividend from it.

* * *

For Mr. Flavelle's statement that contracts were to be taken from contractors General Bertram has an explanation. In fact, the Government apparently left him, not only all the work, but all the explaining besides. When the urgent call came from the trenches for high explosive shells the British War Office naturally turned to the Shell Committee. It had been doing wonderful work and saving immense sums of money. It had business sagacity that could almost equal Sir Sam Hughes' military genius. Exercising that sagacity, and realizing the need of securing these shells in the shortest possible time, the Shell Committee so placed these contracts that they haven't yet been filled. Consequently they are being recalled and placed with firms that can handle them.

* * *

It is wrong to criticize a sick man. But it is also wrong if there are Canadian soldiers filling graves in France because of blundering or profiteering in Canada. General Bertram has centred the Shell Committee in himself. He declares that he alone is responsible for its actions. He alone is attempting to make explanations. And the more explanations he makes the more evident it becomes that a thorough investigation is absolutely necessary.

* * *

One of our subscribers writes us that it is not the duty of trade papers to discuss politics or matters outside of the trade. He may be right. It is true that politics and politicians put the rules of trade carefully to one side before starting to run the biggest business in the country—the country's own business. It is true that no business man would think of running his business on the lines the country's business is run on. He would never think of putting a college professor in charge of a department he knew nothing about simply because he could make a good speech. He would never engage his employees for the simple reason that they had a pull with certain ward politicians. Consequently politics may be a trade apart. But the public have to pay the mechanics who work at this particular trade. Don't you think the said public is entitled to an occasional glance at what its workmen are doing? And how is it going to get it if some paper not "in the game" doesn't break loose occasionally? If a Grit paper criticizes, a Tory paper rushes to the rescue, and the issue is soon lost in the cloud of recrimination that is raised. So sometimes a trade paper stops to wonder why a Government cannot be run along honest business lines, and how long you or I would remain in business if we treated our customers the way the Government treats the public. It is our turn to furnish the public with its "look," and if our readers will bear with us yet a little longer they will discover that they are gazing on the body politic and seeing things, not as they are painted by a Government organ or the opposition critics, but exactly as they are.

* * *

It may be lese majeste to even mention the press censor. His work requires rare judgment and tact. He shows it every time he moves. His attention appears to have been called to this column, but as discussion of things political, including politicians, is allowed under the rules and regulations governing his department, he was powerless to blue-pencil a single sentence. However, you can't keep an industrious chap from doing something. And our censor is industrious. So he picked out certain and sundry paltry paragraphs in our news columns as inimical to the safety of the Empire. With an iron hand he wielded the pen that deprived the public of information as to where a few shell-boxes are being made. The Germans probably looked to the Contract Record for this information, as since its publication was prohibited not a single copy has been sold in Germany. And with this tremendous leak stopped could not the censor find time to look into the ways and works of one Henri Bourassa? If he publishes the stuff charged to him he would appear to be entitled to board and lodging in the internment camps. Then there is "The Hibernion"—a Yankee publication owned by the Germans and edited by a hyphenated chap. I heard a good Irishman discussing it and its editor the other day, and any publication that causes an honest man to use such language is certainly not fit reading for Canadians. Perhaps in the lull following his last grand work the censor can find time to take a look at it anyway.

* * *

When the cry went forth that this was a war of munitions Australia promptly began to mobolize its state-owned shops for munitions work. Did Canada do likewise? No; Canada—or rather the Canadian Government—promptly sidestepped by handing over the Transcona shops to a private syndicate which is doubtless doing a nice business at a nice profit. Had the Government been big enough to seize an opportunity it could have fitted up the Transcona shops with shell-making machinery at a cost of about $100,000, hired the best mechanics in the country, and turned out at least 5,000 shells per day. Moreover, it would then have been in a position to judge from its own experience just what price should be paid for shells. It would have had at first hand information which would have ended profiteering before it started. But probably the entire cabinet were busy making speeches when the opportunity offered. High-explosive speeches had to take the place of high-explosive shells.

* * *

Britain is said to have black-listed certain United States firms suspected of being affiliated with the Empire's enemies. And from the way the Kaiser's friends in the republic across the way have acted since the war began you would naturally expect the old land to be a bit careful as to whom she deals with. Canadians should follow suit. We have no quarrel with the United States. But within her borders are large numbers of the hyphenated, who are all the more dangerous that they are allowed at large among civilized people. Canadians should be careful that no business of any kind should be placed with them, either now or after the war.

* * *

It is reported that A. D. Foster, of King's, N. S., and W. F. Garland of Carleton, Ont., who were compelled to resign their seats in the House of Commons on account of inproper conduct in connection with Government contracts, will seek re-election in their constituencies. This puts the Conservative party in a quandary. The Government of course cannot attempt to accept those discredited men as its candidates, and yet it fears that either or both of them may by reason of personal popularity draw off enough votes from the regular candidate to elect a Liberal candidate. Pretty game, politics, isn't it? It is apparently so full of trickery that most of the players do not entirely blame a man who oversteps the rules and cheats a bit. But the government cannot afford to stand idly by. It must put up regular candidates, and if it cannot whip its followers into line it must take the consequences. Moreover, if either of the offenders should happen to be elected he should be ostracized at Ottawa and made to feel that bleeding the people he was elected to represent is something more than a political misdemeanor.

* * *

The protection of the new industries created by the war and its consequent shell orders is to be made the subject of a report from the Economic and Development Commission. And that report will require the closest scrutiny when it is presented. Even in official Ottawa it is admitted that prices obtained by some manufacturers have been sufficiently high to permit of the scrapping of their plants when the war is over. Of course if these plants can be kept going as business propositions, right and good. But the public will hardly stand for their being fed on Government pap. They've heard so much about munition profits that they'll want to know when the war is over that every Government dollar goes to the man who has fought for his country or those he has left behind him. He who has stayed home and made money will receive scant consideration.

* * *

When Tommy comes marching home he is going to ask the Government if it permitted the handing around of shell contracts "to prevent commercial depression" while his comrades were dying in the trenches for lack of the shells. Will the Government have its answer ready?

SEARCHLIGHT.

Obituary

Mr. John P. Longard, senior partner of the plumbing firm of Longard Brothers, Halifax, N.S., died suddenly recently. Longard Brothers is the oldest business in Halifax. It was founded 103 years ago by the grandfather of the late Mr. J. P. Longard.

The death occurred on December 18th of Mr. William Westlake, of Whitby, Ont. Before he retired from business fifteen years ago Mr. Westlake was a builder and contractor. He erected many buildings in Whitby, Oshawa, Bowmanville, and the surrounding country. The late Mr. Westlake was born in Yorkshire, England, and came to Canada when ten years of age.

Mr. Saxon F. Shenstone, Treasurer of the Dominion Radiator Company, Limited, Toronto, died quite suddenly on the morning of Christmas day. Mr. Shenstone was born in Brantford thirty-seven years ago, and was a son of Mr. Joseph N. Shenstone, Treasurer of the Massey-Harris Company. He began his business career in Hamilton, and continued it in Chicago, returning to Toronto and joining the Dominion Radiator Company seven years ago.

Mr. Graham Fraser, the father of the iron and steel industry in Canada, died suddenly on Christmas day at his home in New Glasgow, N.S. In 1872 Mr. Fraser and Mr Forrest McKay established the Hope Iron Works. When the wooden shipbuilding declined, and there was no more demand for the iron knees, they took up steel-making, and were the first to make steel axles in Canada, creating the steel industry in this country. In 1881 they formed the Nova Scotia Steel Company. Later on others became associated with them, the company acquired coal mines in Cape Breton, the ore deposits in Newfoundland were developed, and the company known as the Nova Scotia Steel and Coal Company came into being.

Pro Patria

Lieutenant Henry Hadley, late engineer of the city of Verdun, P. Q., has been attached to the 148th Battalion, Montreal. He was born in Montreal and educated at the High School and McGill University. He graduated from McGill in 1906, taking the degree of Bachelor of Science

Lieut. Henry Hadley.

in Civil Engineering, and resigned from the position of city engineer of Verdun to go to the front. Mr. Hadley has always been active in athletics, especially in paddling, rowing and boxing, being a well-known member of the M. A. A. A. and Grand Trunk Railway Boating Club. He has also been a provisional lieutenant of the 13th Dragoons since 1914.

Personal

Mr. Mervyn J. Allan, manager of Rocmac Roads, Limited, Toronto, for the last three years, has resigned to accept another position.

Corp. J. J. A. Gillies, a prominent young civil engineer, and a nephew of J. A. Gillies, K.C., French Consul, of Sydney, N.S., is now on active service in France. Corp. Gillies formerly carried on the activities of his profession throughout the Maritime Province and parts of Ontario.

Mr. F. P. Jones, General Manager of the Canada Cement Company, has just been elected a member of the board of directors of the Dominion Steel Corporation. It is also stated that he will probably succeed Sir William Van Horne as Vice-President of the corporation.

Mr. Norman Murray, for the last few years Town Engineer of Weyburn, Sask., is leaving for his old home in Scotland, and will obtain a commission in the Royal Engineers. Mr. R. S. Asher, formerly of the Town Engineer's staff, has just been promoted to a captaincy in the Royal Engineers in England, having left to join that corps on the outbreak of hostilities.

Mainly Constructional

East and West—From Coast to Coast

The Central Engineering Company, Limited, Montreal, have registered.

The M. J. Stack Paving and Construction Company, Limited, of Montreal, have registered.

The Canada Cement Company, Limited, is building an electric furnace at its Montreal plant.

The Shawinigan Electric Metals Company, formed to manufacture metallic magnesium, is constructing a new plant.

The Canada Cement Company, Limited, are extending the scope of this business. Among other lines, they will manufacture and deal in iron, steel, and all other metals.

Recorder Geofrion, in the Recorders' Court, Montreal, has decided that workmen can recover against the owner of a building when they fail to secure their wages from the contractor.

A. J. Flemming and H. G. Stewart have registered at Montreal, and will carry on the business of electrical engineers under the firm-name of the Engineering Company of Canada, Reg.

The Medicine Hat Pump and Brass Company are feeling the pulse of improving business. At the present time they have two hundred orders on hand for their pumps, and are employing over fifty men.

Canadian Steel and Brass Products, Limited, is the name of a new Toronto concern with a capital of five hundred thousand dollars. The provisional directors are A. Ogden, A. T. Bowlby, and G. Prior.

The Canadian Car and Foundry Company has secured an order for nearly two thousand freight cars, valued at about $2,000,000, for the French Government. Work on the order is to be started at once.

Mr. J. C. Stewart, head of the Canadian Stewart Company, who is in Toronto superintending the closing up for the season of the harbor works, expresses himself as satisfied with the year's work on the new harbor.

The ninth annual meeting of the Nova Scotia Society of Engineers lately in session at Halifax elected the following officers: President, J. L. Allan; First Vice-President, A. J. Barnes; Secretary-Treasurer, D. McD. Campbell.

Mr. John Quinlan, president, and Mr. D. K. Trotter, secretary, of the Montreal Builders' Exchange, represented that body on a large deputation which waited on Sir Lomer Gouin asking for a reform in the methods of governing the city.

An order for a large number of new locomotives for the National Transcontinental Railway has been given by the Dominion Government. This has been made necessary by the prospect of an enormous wheat traffic, estimated at approximately one hundred cars a day.

The Railway Commission of Ottawa has issued an order for the construction by the Toronto, Hamilton and Buffalo Railway of a new highway bridge in Hamilton carrying the line of King Street over the railway tracks. Seventy per cent. of the cost is to be borne by the company and 30 per cent. by the city.

The Bricklayers' Union, which financially and numerically is the strongest labor body in Western Canada, held its annual meeting in Winnipeg on December 27. The following officers were elected: Thomas Williams, president; Joseph Currie, vice-president; Joe Coulter, business agent; E. S. Jackson, treasurer.

The Electric Welding Company of Toronto, Limited, is the name of a new concern with head office in Toronto and a capital of $40,000. The provisional directors are W. H. Irving, H. H. Davis, and J. R. Rumball, all of Toronto. The company will carry on the business of electrical, mechanical, hydraulic, and civil engineers and contractors.

A paper on "Concrete T-Beams" by Mr. E. G. W. Montgomery, of the Highway Department of the Government of Saskatchewan, will form the principal attraction on the programme for the next meeting of the Regina Engineering Society. The meeting will be held in the Commercial Club at 8 o'clock on the evening of January 6, and will be preceded by a luncheon at 6.30 p.m.

The report of the committee of engineers appointed by the Calgary branch of the Canadian Society of Civil Engineers to investigate the charges made by Alderman A. W. E. Fawkes with respect to the work of the City Engineer, Mr. G. W. Craig, on the construction work of the Centre Street Bridge, Calgary, fully vindicates Engineer Craig, finding the charges made against him unjustified.

All the plans, profiles and field work records of the proposed new three-million-dollar Elbow River water works system, Calgary, Alta., which cost in the neighborhood of $10,000, are missing from the water works vault. A letter from Buffalo, N.Y., signed Oleson, says the writer overheard a plot to destroy these data in order that the men in the surveying department might have another year's work.

In the opinion of Commissioner Garden, the city of Calgary was badly "stung" by the contractor who put in the old pier under the Ogden traffic bridge. This pier rested on the soft earth of the river-bed, and in consequence settled when the July floods washed the bottom from under it. The city is replacing it by a new pier at great trouble and expense. In order to secure a sure foundation, the new pier has to be carried down some twenty feet further than the old one.

The Dominion Bridge Company, of Montreal, are setting an example in the way of patriotism which it is to be hoped will be emulated by many other firms who are making large profits out of war orders. At their annual shareholders' meeting on December 16th the following resolution was passed: "Resolved, that the meeting approve and authorize a contribution to the National Canadian Patriotic Fund for 1916 of two per cent. of the gross amount received on ammunition orders to the end of the calendar year."

The township Council of Sydenham, Ont., are taking up the matter of improved roads, and will take advantage of the plan available under the Colonization Roads Act, by which the Provincial Government stands half the cost of building main roads. The amount suggested to be spent next year is $2,000, to which the Government is expected to add another $2,000, and with this amount it is proposed to improve the three main roads—the Owen Sound-Meaford road, the Derby line, and the Lake Shore-Garreyowen road.

Commissioner Wigmore, of the St. John, N.B., City Council, showed his colleagues two pieces of lead weighing together more than fifty pounds, encrusted and rusty, which had been taken out of the 12-in. main that is being cleaned—the last of the series of city pipe-lines from Little River. These large pieces had been at some time or other poured into joints of the pipe while being repaired and had "run" on the inside of the piping. The wastefulness of such methods of repairs was shown in the fact that the incrusted part alone contained more than enough lead to solder properly any 24-in. joint.

Mr. E. B. Ford, chief engineer for Vancouver and district for the Great Northern Railway, has completed the work of driving test piles in the site of the foundation of the station which the railway company proposes to erect in False Creek, B. C. Mr. Ford states that as the result of these tests it is known that piles of a length ranging from 40 to 60 feet will be necessary. These will be driven below the level of permanent saturation, and because they will always be wet they are expected to last for a long time. Fir is the wood selected. On top of these piles concrete will be poured, and the granite base of the station will be built on the concrete. Mr. F. L. Townley, the architect of the station, is expected to return to Vancouver from the company's head offices at St. Paul later in the week.

The Union Cement Company, of Owen Sound, Ont., have received an order for approximately one hundred thousand barrels of cement—or the entire supply for the different departments of the city of Toronto for the year. In order to get the order under way in time for the opening of the season's work in the city the big cement mill will be started on Feb. 1st, several months earlier in the season than usual. Another contract for forty thousand barrels has been landed. With these two orders on hand, together with their regular trade, the company are looking forward to a large season's business. A staff of from 80 to 90 men is required when the plant is in operation, and this is another indication that employment will be plentiful in Owen Sound during the year 1916. The Union Cement Company have severed their connection with Alfred Rogers, Limited, and will hereafter be an independent concern.

The Ottawa Journal calls attention to the fact that December 22nd marked the fifty-sixth anniversary of the cutting of the first sod for the foundations of the Dominion Parliament Buildings, the ceremony of laying the corner-stone by Edward VII, then Prince of Wales, taking place a year later This fine example of Gothic architecture has already become historic, and visitors who come to see it go away with their minds enriched. The architect was Thomas Fuller, an Englishman of great ability who had settled in Toronto. When plans were called for Fuller's were easily the best, and little time was occupied in getting to work. When he had finished this work, in 1867, he won the prize for the best design for the Legislative Buildings at Albany, and removed there to superintend this other magnificent work. He remained in the United States until 1881, when he was invited to become the chief Dominion architect, succeeding the late Mr Scott, who had been chief architect since 1871. He occupied this position until 1897, when he resigned and Mr. Ewart was appointed in his stead. Mr. Fuller was an old man then, and died about a year after.

One of the largest, if not the largest, pipe-line and gas propositions of the continent has just been consummated by the disposal in New York of the bonds of a project to pipe gas from Southern Alberta to Winnipeg, Brandon, Regina, Moose Jaw, and all other important towns along the line of the Canadian Pacific in the western prairies. Behind the proposition are Calgary financial men, the engineer for whom is Mr. J. L. Kempher. It is announced that work on the project will be commenced during the first week of January, and that the construction will cost approximately ten million dollars, consisting of two pipe-lines with great compression stations, and that the work will employ a large number of men as soon as it is fully under way. The Calgary men conceived this idea of piping gas on this, probably the largest gas project yet attempted so far as length of piping is concerned, some months ago. The proposal was gone into thoroughly, some of the best engineers of the United States and Canada reporting on its feasibility before any definite steps were taken. Among the engineers were representatives of Ford Bacon & Davis, engineers for the Pennsylvania Gas Company, and the People's Gas Company of Philadelphia and Pittsburgh. Their reports showed the scheme to be practicable, and then negotiations were begun with Winnipeg and an offer was made to that city to supply gas at a certain figure which could not yet be ascertained. Winnipeg, it is learned, agreed to accept the offer if the city attorneys were assured of the financial success of the enterprise. This is now given by the taking over of the bonds by one of the largest financial firms in New York.

The Croaker

Once on the aidge of a pleasant pool,
Under the bank where 'twas dark and cool,
Where bushes over the water hung,
And rushes nodded, and grasses swung,
Jest where the crick flowed outer the bog,
There lived a grumpy and mean ole frog,
Who'd set all day in the mud and soak
And jest do nothin' but croak and croak,
Till a blackbird hollered, "I say, yer know,
What is the matter down there below?
Are you in trouble, er pain, er what?"
The frog sez, "Mine is a orful lot;
Nothin' but mud and dirt and slime
For me ter look at jest all the time
It's a dirty world!" so the old fool spoke,
"Croakity-croakity-croakity-croak!"

"But yer lookin' **down!**" the blackbird said;
"Look at the blossoms overhead,
Look at the lovely summer skies,
Look at the bees and butterflies;
Look **up,** old feller. Why, bless yer soul,
Yer lookin' down in a muskrat hole!"
But still with a gurglin' sob and choke
The blame ole critter would only croak.
And a wise old turtle, who boarded near,
Sez to the blackbird, "Friend, see here:
Don't shed no tears over him, fer he
Is low-down, jest 'cause he likes ter be;
He's one er them kind er chumps that's glad
Ter be so mis-rable-like and sad;
I'll tell yer somethin' that ain't no joke,
Don't waste yer sorrer on folks that croak."

—From "New Age"

Trade Publication

Condenser Work—The Wheeler Condenser and Engineering Company, Carteret, N. J., are distributing three new books—(1) Steam Tables for Condenser Work, third edition; (2) Psychrometric Tables for Cooling Tower Work; and (3) a combined cloth-bound volume of these two books. Paper-bound copies of these books are available without charge to any engineers who may write the company.

An Asphalt Primer

The Barber Asphalt Paving Company, Philadelphia, have issued an interesting little booklet entitled "The Asphalt Primer and Colloidal Catechism." This is an explanation, in question and answer form, of the principles of colloidal chemistry as applied to the paving industry. An asphalt mixture, it is explained, must be regulated on the basis of surfaces and films. The presence of colloidal matter such as has been discovered in Trinidad asphalt enormously increases the surface area of the aggregate, and results in a more closely-held and thicker film of bitumen about the particles of the aggregate. The primer is illustrated with wood cuts of ancient and modern highway building

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Burlington, Ont.
Tenders will be received by the Town Clerk, James S. Allen, on the supply of 850 feet of 30-inch concrete pipe.

Calgary, Alta.
Plans and profiles have been prepared by the City Engineer, G. W. Craig, for the construction of a waterworks system, estimated to cost $3,000,000.

Kincardine, Ont.
The Town Council are considering the construction of a reservoir and a pipe line. Engineer, A. Ingram. Estimated cost, $5,000.

Listowel, Ont.
The Town Council are considering the construction of a pavement on Main St. Clerk, William Bright.

North Vancouver, B.C.
Estimates are being prepared with regard to the construction of a pumping station for the supply of water to the Capilano Section. Engineer, A. M. West.

Ottawa, Ont.
The City Engineer, F. C. Askwith, is preparing plans for a driveway to be constructed along the Rideau River. Work on grading will start at once by day labor.

Quebec, Que.
Work by day labor is about to start on waterworks and drainage construction, estimated to cost $25,000. Waterworks Engineer, T. A. J. Forrester.

Toronto, Ont.
The Board of Control will receive tenders until January 11th for the supply of special iron castings for the Main Pumping Station. Specification at Room 12, City Hall.

Vancouver, B.C.
Work will start in the spring on the construction of the Stanley Park Sewer for the Vancouver & Districts Joint Sewerage & Drainage Board, 718 Granville Street. Engineer, A. D. Creer. Approximate cost, $130,000.

The City Council are negotiating with the Hastings Mill Company with regard to repairing the Seymour Pipe Line Road, of which the Company are the principal users. Estimated cost, $6,560. Engineer, F. L. Fellowes.

Railroads, and Bridges Wharves

Dunville, Ont.
The proposed work at Dunnville will include the construction of a ferry slip, turning basin, and considerable dredging in the mouth of the Grand River. This latter will be done by the Dominion Government under supervision of A. R. Dufresne, Assistant Chief Engineer of the Department of Public Works.

Hamilton, Ont.
The Toronto, Hamilton & Buffalo Railway, Hamilton, have been authorized to construct a bridge on King Street over the tracks.

Moncton, N.B.
The Moncton Tramways, Electricity & Gas Company, Limited, 38 Mechanic Street, will start work in the spring on the construction of 1½ miles of track. General Superintendent, A. B. Coryell.

St. John's, Que.
Plans and specifications for the construction of a bridge have been received by the Town Council from the Provincial Government. Clerk, J. A. Raymond.

Toronto, Ont.
The Board of Control will receive tenders until January 11th for the supply of red lead paint required for the Bloor Street Viaduct. Specifications at Room 12, City Hall.

CONTRACTS AWARDED

McNab Township, Ont.
The Township Council have let the contract for the construction of a bridge over Waba Creek to John Stewart, Waba. Wood construction.

Quebec, Que.
In connection with the construction of a dry dock for the Dominion Government Department of Public Works, the contract for glazing has been awarded to G. B. Mitchell, Jacobs Building, Montreal, and for the supply of coal and ash handling machinery to the Canadian Link-Belt Company, 1189 King Street West, Toronto, Ont.

Public Buildings, Churches and Schools

Alberta Province
Plans are being prepared by F. Blakey, Parliament Buildings, Edmonton, for the erection of an institution for the mentally defective.

British Columbia Province
The Provincial Government have decided to erect an institute for imbeciles. Minister, Hon. H. E. Young, Victoria.

Fredericton, N.B.
Tenders will be received until 4 p.m., January 18th, by R. C. Desrochers, Department of Public Works, Ottawa, for the installation of interior customs fittings. Plans and specifications with L. Yerxa, Caretaker, Fredericton, D. H. Waterbury, Clerk of Works, St. John, and at the Department. Specifications only at office of MacLean Daily Reports, Limited, 25 Charlotte Street, Toronto.

Listowel, Ont.
Interior repairs to the Methodist Church are being considered. Work will include a heating plant, leaded glass windows and decoration, and is estimated to cost about $9,000. Pastor, Rev. J. E. Millyard.

Manitoba Province
The erection of an institute for the deaf and dumb has been decided upon by the Provincial Government. Minister, Hon. G. R. Coldwell, Winnipeg.

Quebec, Que.
No tenders will be called for the seating required in connection with the school now being built at Seventh St. and Eighth Avenue for the Roman Catholic School Commissioners.

Saskatchewan Province
The Provincial Government have decided upon the erection of an institution for the blind. Minister, Hon. Walter Scott, Regina.

St. Catharines, Ont.
The Congregation of Haynes Avenue Presbyterian Church intend to build a hall in the spring. Work will be done by day labor under supervision of Thomas Mesler, 188 Queenston Street.

St. Marie, Que.
Repairs to the Roman Catholic Church are being considered. Work will include new flooring, electric lighting and painting. Curate, J. E. Teuiltant.

Toronto, Ont.
Tenders will be received until 4 p.m., January 10th, by R. C. Desrochers, Department of Public Works, Ottawa, for the erection of temporary Postal Station A at Bay and Front Streets. Steel truss and galvanized iron construction, concrete and brick piers. Plans and specifications at office of T. A. Hastings, Postal Station F, Toronto, and at the Department.

Tenders will be received until January 26th by E. F. Henderson, Chairman of the Sites and Building Committee of the Separate School Board, for the following:—(a) erection of St. Clare's School; (b) erection of St. Monica's School; (c) addition to St. Anthony's School; (d) addition to St. Joseph's School. Plans and specifications at office of the Architect, C. J. Read, 203 Confederation Life Building.

CONTRACTS AWARDED

Montreal, Que.
In connection with the presbytery now in course of erection on St. Joseph Boulevard for the Trustees of St. Pierre Claver Church, the contract for heating has been let to G. Champagne, 78a Inspector Street.

Montreal North, Que.
The following contracts have been let in connection with the Town Hall which is now being built:—carpentry, Bourgon, Gagne & Company, 1882 Notre Dame Street W., Montreal; brick work, C. Morin, 2572 Christopher Columbus Street; plastering, C. Malhiot, 535 Alma Avenue; painting, A. Wilton; roofing, heating and plumbing, Bastien & Vaillancourt, 962 Papineau Avenue; electrical work, J. A. St. Amour, 2171 St. Denis Street; architectural iron work, Montreal Architectural Iron Work Company, 157 Prince Street.

Portage La Prairie, Man.
The Department of Public Works, Ottawa, have awarded the contract for electric wiring and fittings to Houston & Company, 215 Saskatchewan Avenue, Portage la Prairie.

Roberval, Que.
The School Commissioners have let the contract for roofing, heating and plumbing in connection with the school now being built to A. Binette. Plastering, painting and electrical work not yet awarded.

Business Buildings and Industrial Plants

Hamilton, Ont.
The Hammant Steel Car Company are considering the erection of an addition to their factory on Kenilworth Avenue. Manager, J. Marsella.

The proposal to erect an abattoir will be considered in the year by the City Council. Clerk, S. H. Kent.

Leamington, Ont.
The Town Council propose to grant a site for three warehouses to the Rock City Tobacco Company, 224 Dorchester Street, Quebec, and have appointed a Committee to purchase it. Manager of the Company, W. Druin, Quebec. Approximate cost of buildings, $25,000.

Leonardville, N.B.
W. D. Welch has decided to rebuild his store and factory, but will not start work until the spring.

Levis, Que.
The Bell Telephone Company of Canada are considering the erection of an exchange building on Wolfe Street, and will have plans prepared. Local Manager, F. Belcourt.

Lion's Head, Ont.
The Lion's Head Milling Company propose to rebuild their flour mill.

London, Ont.
The Parnell Baking Company, 75 Bruce Street, contemplate the enlarging of their equipment. Work may start in the spring. Manager, E. Parnell. Estimated cost, $25,000.

Manitoba Province
The Provincial Government have secured a site for a Prison Farm and contemplate the erection of a number of buildings. Minister, Hon. T. H. Johnston, Winnipeg.

Moose Jaw, Sask.
The Robin Hood Mills, River Street W., Moose Jaw, propose to erect a number of flour mills in the Western Provinces.

New Westminster, B.C.
The City Council have had tentative plans prepared for a market building to cost about $35,000. Architect, F. G. Gardiner, 328 Third Street.

Ottawa, Ont.
Work is about to start on repairs to the plant of the Pritchard & Andrews Engraving Company, 269 Sparks Street. Owners will purchase material.

In connection with the addition now being built at the factory of the Capital Wire Cloth Company, Armstrong Street, most of the work will be done by day labor.

St. Catharines, Ont.
A. Puccini & Company, 55 Front Street E., Toronto, have had plans prepared for alterations to the Stevenson Building. Work includes concrete floors and removal of partitions. Architect, J. W. Siddall, Confederation Life Building, Toronto.

Toronto, Ont.
The addition which is now being built at the factory of the Canada Metal Company, Fraser Avenue, will be of brick and steel construction. Approximate cost, $10,000.

James A. Wickett Limited, Traders Bank Building, are receiving sub-tenders on all work and material required in the erection of a Hydro Transformer Station at St. Thomas. Tenders must be in by January 14th.

Vancouver, B.C.
Plans are to be prepared at once for alterations to a store at Hastings and Abbott Street for the Woodward Department Stores Limited. Tenders will be called during January. Estimated cost, $6,000.

CONTRACTS AWARDED

Brampton, Ont.
In connection with the addition now being erected at the factory of the Copeland Chatterson Company, the painting contract has been awarded to James Harmsworth, Brampton.

Fort Erie, Ont.
Work has been started on razing old buildings on Niagara Street preparatory to the erection of a bakery and residence for E. Hawkins. The general, carpentry and roofing contracts have been let to C. W. Taylor, Bridgeburg, Ont. Frame construction, concrete foundation, shingle roofing. Approximate cost, $5,000.

Montreal, Que.
Work has been started on the erection of a storage building for Matthews-Blackwell Ltd., Mill Street. The general contract has been let to P. C. Currans Company, 1002 Cartier Street, and the carpentry to Thomas Harrison, care of general contractor. Frame construction, concrete foundation, felt and gravel roofing. Approximate cost, $3,000.

In connection with the conversion of premises at 59 Park Avenue into a store for B. Dixon, 83 Craig Street West, the contract for roofing has been let to Richardson, Simard & Company, 745 Clarke Street, and the mill work to R. Macfarlane & Company, Ltd., St. James Street.

Ottawa, Ont.
In connection with the addition now being built at the factory of the Capital Wire Cloth Company, Armstrong Street, the contract for iron work has been awarded to the Canadian Agency & Supply Company, Booth Building, Sparks Street, and the brick work, concrete and roofing to the general contractors, Cuthbertson & Clark, 706 Echo Drive. Heating by owners. Plumbing and electrical work will be awarded in the spring.

Paris, Ont.
In connection with the factory now in course of erection for the Paris Wincey Mills Company, Limited, the plumbing contract has been awarded to Charles Taylor & Company, 12 Dalhousie Street, Brantford.

Sherbrooke, Que.
The following contracts have been let in connection with the machine shop which is being built for the Canadian Ingersoll Rand Company: roofing, Campbell, Gilday & Company, Limited, 793 St. Paul Street, Montreal; painting, Paquette & Son, St. Francis Street; heating, plumbing and sprinkler system, General Fire Extinguisher Company, 374 Beaumont Street, Montreal. Carpentry by the general contractor.

St. John, N.B.
The contract for steel work required in connection with the Young Men's Club which is now being built has been let to the Eastern Canada Steel & Iron Works, St. Malo, Que. Architect, R. A. Frechet, 30 Bonnacord Street, Moncton.

Vancouver, B.C.
The contract for painting required at the bank vault building which has been erected on Grandview Avenue for the Canadian Bank of Commerce has been let to the Vancouver Decorating Company, care of William F. Gardiner, 347 Pender Street West.

The Hudson's Bay Company, Georgia Street, have let the general contract for an addition to their store to the British Columbia Construction & Engineering Company, Fisgard and Douglas Streets, Victoria. Work will start at once. Brick construction. Approximate cost, $25,000.

Residences

Niagara Falls Centre, Ont.
W. C. Pretty, 751 Ferry Street, is considering the erection of a residence and garage to cost about $6,000. Work may start in January. No contracts yet awarded.

Ottawa, Ont.
Mrs. Charlebois, Springhurst Street and Beechwood Avenue, intends to rebuild her store and residence which were recently destroyed by fire. Frame construction. Approximate cost, $3,000. Work by day labor.

Plans are being prepared for a residence to be erected on Fentiman Avenue by F. Nunn, care of Ritchie & Nunn, 165 Sunnyside Avenue. Brick veneer construction, concrete foundation, shingle roofing. Contracts will be let for plastering, heating and plumbing. Estimated cost, $4,000.

The erection of a residence on Electric Street is being considered by Herbert

Cotter, 80 Vaughan Street. Double brick veneer construction, concrete foundation, felt and gravel roofing. Approximate cost, $4,000.

Tenders on brick work, roofing, plastering, painting, heating, plumbing and wiring required in the erection of a residence are now being received by the Estate of John O'Leary, 208 Laurier Avenue. Brick veneer construction, felt and gravel roofing. Approximate cost, $4,500.

Toronto, Ont.
H. B. Jackson, 134 Bracken Avenue, has commenced the erection of a residence, estimated to cost $4,500. Smaller trades will be let. Brick construction, shingle roofing.

Work has been started by A. M. Crawford, 44 Beech Avenue, on the erection of a residence. Smaller trades will be let. Brick construction, shingle roofing. Approximate cost, $3,000.

CONTRACTS AWARDED

Hamilton, Ont.
In connection with the residence which has been erected at Herkimer and McNab Streets for R. Kirkpatrick, the contract for heating and plumbing has been let to P. A. Moore & Company, 939 King Street E. Electrical work not yet awarded.

Lachine, Que.
B. Desmarais is building a residence on Aberdeen Avenue for George Marcil, 180 St. James Street, Montreal. Brick construction, concrete foundation, asbestos roofing. Estimated cost, $3,000.

Montreal, Que.
In connection with the residence which is being built on Delorimier Avenue for J. B. A. Aubry, the contract for painting has been let to Girard & Boucher, 291 Iberville Street, and the roofing, heating and plumbing to Vaillancourt & Bastien, 692 Papineau Avenue. Masonry, brick work and carpentry by the general contractor, J. Pilon, 2044 Bordeaux Street.

Work has been started by Anglin's Limited, 65 Victoria Street, on the erection of a residence on Draper Avenue for E. W. Herring, 2 McGill College Avenue. Tenders are now being received for roofing and electrical work. Brick construction, concrete foundation, felt and gravel roofing. Estimated cost, $4,000.

The contract for steel work required in connection with the flats which are being built on Grand Boulevard for G. N. W. Zwinge, 296 Madison Avenue, has been awarded to the Dominion Bridge Company, Limited, Lachine, Que.

The contractors for the residence which has been erected on Old Orchard Street for J. C. Rancourt, 115 Melrose Avenue, are as follows:—brick work, A. Pepin, 18 de Gaspe Avenue; roofing, F. X. Goudreau, 255 Visitation Street; plastering, Henry Dedewarder, 45 Pie IX Avenue; glazing and painting, J. H. Cox, 241 Melrose Avenue; electrical work, Simard & Fanteux, 77a Bourget Street.

Ottawa, Ont.
William O'Connor, 495 Somerset St., is building a residence in Ottawa East, estimated to cost $5,000. The contract for heating and plumbing has been awarded to J. P. Rand & Company, 775 Bank Street. Painting by owner.

The following contracts have been awarded in connection with the residence which is being built on Bethany Road for Victor Joyce, 162 Spadina Avenue:—general, carpentry and roofing, Charles J. Joyce, Somerset Street; brick work, Thomas Dean, 21 Stirling Street; heating, J. Cameron, 488 Lewis Street; plumbing, J. T. Blythe, Frank Street; electrical work, H. L. Allan, 377 Somerset Street. Brick veneer construction, stone foundation, shingle roofing. Approximate cost, $4,000.

The contract for plastering required at the residence which has been built on Brighton Street for H. Puddicombe, 410 Queen Street, has been awarded to J. Jarvis, 18 Fourth Avenue ,and the heating to the Capital Hardware Company, Bank Street.

Quebec, Que.
The contract for heating, plumbing and electrical work required at the residence which is being erected on Charlesbourg Road by Lavoie, Martel & Beaupre, First Avenue, Domaine Lairet, has been awarded to A. Noreau, Fifth Avenue, Domaine Lairet.

Sarnia, Ont.
McWater Bros., 254 Cromwell Street, have commenced the erection of a residence for Frank Williamson, 260 Maxwell Street. Frame construction, shingle roofing. Estimated cost, $3,000.

Toronto, Ont.
The contract for heating and plumbing required at the residence and garage which have been built at 35 Munro Park Avenue by R. E. Oliphant, 117 Willow Avenue, has been let to Stratton & Cook, 314 Lee Avenue.

Verdun, Que.
Work has been started by Anglins Limited, 65 Victoria Street, on the erection of two flats on Rielle Street for W. T. Tipping, 257 Gordon Avenue. Brick veneer construction, felt and gravel roofing. Approximate cost, $3,000.

Westmount, Que.
In connection with the residence which has been erected on Sunnyside Avenue for L. J. Ryan, 545 Notre Dame Street W., Montreal, the contract for mantel and tile work has been awarded to G. R. Locker Company, 143 Mansfield St., Montreal, and the hardware contract to Durand Hardware, 370 St. James Street, Montreal.

Power Plants, Electricity and Telephones

Brooke Township, Ont.
The Secretary of the Brooke Municipal Telephone Company, who are considering the extension of their system ,is R. J. Lucas, Watford, Ont. Manager, R. Chapman, Inwood, Ont.

St. Come, Que.
Work will start soon on the construction of an electric system for La Compagnie d'Energie Electrique. Particulars from the Mayor, Dr. Poliquin.

The Pas, Man.
The by-law authorizing the installation of a telephone system at a cost of $12,000 has been carried. Town Clerk, H. H. Elliott.

Fires

Brooks, Alta.
Fire has destroyed the pool room owned by W. R. Winters, and the store belonging to F. Ainlay. Total loss, about $10,000, partly covered by insurance.

Chatham, Ont.
The carriage works of William Gray, Sons & Campbell, Limited, 78 William Street, have been destroyed by fire.

Crow Lake, Ont.
The residence of James Mahan has been destroyed by fire. Loss covered by insurance.

Frome, Que.
Fire has totally destroyed the barn and outbuildings owned by Robert S. Chute. Loss partly covered by insurance.

Goderich, Ont.
Fire has entirely destroyed the barn belonging to Robert McAllister, Seventh Concession, W. Wawan.

Jamestown, Ont.
The factory of the Jamestown Table Company has been destroyed by fire. Loss, about $2,000, covered by insurance.

North Bay, Ont.
The store owned by Dole & Son has been damaged by fire.

Ottawa, Ont.
Fire has damaged the stores at 195-199 Bank Street, the property of S. A. Luke, 59 Rideau Street. Loss, about $4,000.

Princeton, Ont.
The flour mill owned by Maycock & Harris has been totally destroyed by fire. Loss, $10,000.

Saskatoon, Sask.
The storage building of the Northern Storage, 455 First Avenue N., has been completely destroyed by fire. Loss, $60,000.

St. Francois Xavier, Man.
The Roman Catholic Convent has been totally destroyed by fire. Loss, about $10,000.

Toronto, Ont.
The premises of the William Radford Company, 212 Adelaide Street W., have been damaged by fire. Loss on building and stock, about $6,500.

Weedon, Que.
The premises of the Weedon Chemical Company have been destroyed by fire. Loss, about $10,000, covered by insurance. The Company intend to rebuild immediately, and will require cement, steam boilers and chemical fabrication machinery.

Miscellaneous

Creemore, Ont.
John Cotril, Creemore, is in the market for two motors, 1 and 2 horse power, single-phase, 60-cycle.

New Waterford, N.S.
The Town Council propose to purchase a motor fire truck with engine and force pump. Estimated cost, $10,000.

Ottawa, Ont.
The City Council will call for tenders early in the year for the supply of stone for 1916. Engineer, F. C. Askwith.

CONTRACTS AWARDED

Peace River Crossing, Alta.
The Edmonton, Dunvegan & British Columbia Railway Company, Edmonton, have let the contract for oil drilling to J. D. McArthur, E.D. & B.C. Yards, St. Albert Trail. Work will start at once on the installation of drilling plant.

Terra Cotta Society to Advertise

Twenty thousand dollars will be spent next year in a national advertising campaign to educate architects and builders in the merits of terra cotta as a building material—that is, if the plans made at the annual convention of the National Terra Cotta Society, held recently at the Hotel LaSalle, Chicago, Ill., are carried out.

In the past few years especially, terra cotta has been forging to the front as a beautiful, economical and durable facing for building fronts and interior decoration. Those architects and builders who are more progressive than the rank and file—and a trifle more open-minded—have fully realized the merits of this form of decoration and are using it to advantage, securing artistic work of lasting quality at a cost that is pleasing to the average client. But this is not enough. Ignorance as to these merits on the part of the vast majority of those engaged in the building professions and trades, who should be more consistent users of terra cotta, has stood in the way of its advancement. It is to supply this lack of information, that the society has determined upon a nation-wide publicity campaign, the appropriation for which will, no doubt, be increased as the work develops. A committee was appointed to take the project in hand, the personnel of which has not as yet been announced.

President Fritz Wagner called the convention to order at the opening session, the usual procedure being followed, including the annual reports of the officers and various committees which had been appointed for the year just closing. A number of new committees were then appointed for which considerable work was outlined to be accomplished during the coming year, along lines of general interest to the society and the development of co-operation among the members in the industry.

On Friday evening, December 10, a banquet was held at the Hotel LaSalle at which Thomas Armstrong, of the Conkling-Armstrong Terra Cotta Company, Philadelphia, was toast-master. Short talks were given by a number of the members.

The election of officers was held on Saturday afternoon, December 11, Fritz Wagner being re-elected president. Thomas Armstrong was chosen as vice-president; Harry Lucas, of the Northwestern Terra Cotta Company, Chicago, secretary; and E. V. Eskensen, of the New Jersey Terra Cotta Company, Perth Amboy, N. J., treasurer. From fifty to sixty delegates were present at the convention, representing twenty-seven different companies.

The consensus of opinion of those present was that 1916 will be a very prosperous year in the industry. "The terra cotta trade has been greatly depressed," said one of the members, "but within the last month or so there has been rapidly growing evidence of returning activity. Building prospects are now excellent in all parts of the country."

Cement-Coated Piles Repaired Under Water

Wooden piles, wrapped with wire-mesh reinforcing and coated with concrete by means of a cement gun were used by the P. J. Carlin Construction Company in building the San Juan bulkhead in Porto Rico, and described by Mr. Carlin recently in the Cornell Civil Engineer. In applying the coating the piles were carried on roller supports 40 feet apart. As the concrete applied to each pile was 2½ inches thick, the additional weight of the coating averaged 5,000 to 6,000 pounds, which caused some of the piles to sag in turning and handling, producing cracks in the coating.

It may be of interest to explain the methods of repairing the damaged cement coated piles under water. This was done by putting on a steel cylinder, about 6 inches larger in diameter than the coated pile, and around the part of the pile to be repaired. All joints were closed and the bottom of the cylinder was made to fit close to the surface of the pile, with the top of the cylinder open. On the deck, above the pile to be repaired, a tank was set up, with a large valve connected to a piece of 1½-inch single ply cotton hose, leading down to the bottom of the space between the pile and the cylinder. Cement grout was mixed in the tank and allowed to run down the hose, a diver keeping the lower end of the hose below the surface of the deposited cement until the top of the cylinder was reached. The cylinder was allowed to remain on for two or three days, then it was taken off and transferred to another pile to be repaired. The results were considered very satisfactory.

It is believed that if some method of rotating the pile, without sagging, during the application of the "gunite" can be devised, and also of handling the pile from the rollers to the seasoning yard, that this method can be satisfactorily, and, of course, economically, employed. It is undoubtedly less expensive than the solid concrete pile.

Mr. Carlin believes that a coating of about 1¼ inch would be very much bettem than 2½ inches, because it reduces the weight on the wooden-pile, and it sufficiently covers the reinforcement.

Germans Awarded Prize in Swedish Harbor Plan Competition

The first prize in the International competition for plans to enlarge its harbor was awarded by the city of Helsingborg, Sweden, to the firm of Ludwig Lange, Hanover, together with Marine-Hafenbaudirektor Behrendt, Wilhelmshaven, Germany. Albert Lilienberg and Lieut. N. A. Svenson, Gothenborg, Sweden, were awarded the second prize. The third prize went to Thuresson & Company, Stockholm, Sweden. The judges also recommended the purchase of the following, at $270 each: plans of Prof. R. W. Otto Schulze, assisted by Walter Rouff, Danzig, Germany; those by Ivar Tybjerg, Aalborg, Denmark, and those by Carl Semler and the Contractor Construction Company, Stockholm, Sweden. The harbor department itself decided to buy at the above mentioned figures the projects submitted by Lieutenant Plomann, Stockholm, and S. Ewald, city engineer of Helsingborg, assisted by the architectural firm of Lewerentz & Stubelius.

The time limit of the competition was set for July 15, 1914. The judges met for the first time August 1, 1914, but the work was interrupted the following day by the outbreak of the European war. It was not resumed until August 12, 1915, and it was completed August 24. Because of the unexpected length of time required before results were announced it was decided to increase the prizes and the sums of purchase to the extent of interest for one year at five per cent.

Million Acre-Feet Added to Reclamation Service Storage Capacity

More than 1,000,000 acre-feet were added to the capacity of its storage capacity by the U. S. Reclamation Service during the past year. Four large and interesting dams were brought practically to completion, namely: The Arrowrock, the highest in the world; the Elephant Butte, which impounds the largest quantity of water of any artificial reservoir in the world except Gatun Lake; the Grand River, which is the longest roller-crest dam in the United States, and the Lahontan. Water was furnished to irrigate more than 750,000 acres of land and to grow crops worth $16,500,000. The total expenditure during the year for building dams and other irrigation works was $15,000,000. Construction completed included 753 miles of canals, 284 miles of waste-water ditches and open drains, 60 miles of irrigation and drainage pipe lines, 747 bridges, 1,079 culverts, 311 flumes, 51 miles of roads and 178 miles of telephone lines. Irrigation canals were lined with concrete to a total length of 54 miles. The excavation of earth and rock amounted to 17,000,000 cu. yds. and 750,000 cu. yds. of concrete were placed.

Depressed Kiln Centres Save Ware and Bagwalls

"One idea has saved me thousands of dollars," said a New York brickmaker in discussing the subject of kiln construction.

"An item of no mean consideration in the maintenance cost of kilns comes from damaged bagwalls due to the brick rolling toward that part of the kiln. But what is of still greater importance is the amount of ware spoiled when this occurs. I have found that by depressing my kiln centres from one and one-half to two inches in a thirty-foot round, down-draft kiln, much of the trouble, expense and actual loss due to damaged bagwalls, and distorted and melted brick, is obviated. Where this is done, when the brick begin to roll, the tendency is to lean toward the centre of the kiln, thus keeping the setting intact.

"This simple idea has saved me a large sum of money in the time that I have made use of it, in repairs to bagwalls and in a smaller number of culls."

Tenders and For Sale Department

School Tenders

Sealed tenders will be received up to and including **Saturday, January 15, 1916,** by the Secretary of the School Board, Lambton Mills, in whole or in part, for the different trades required in the erection and completion of a school building. Plans and specifications and all particulars can be seen at Molson's Bank, Lambton Mills; also at the offices of the architects. No tender necessarily accepted. A guarantee bond for 10 per cent. will be required from the parties to whom the contract may be awarded.

THOMAS ELLIOT,
Secretary-Treasurer School Board,
Lambton Mills, Ont.

Ellis & Ellis, Architects,
Manning Chambers, Toronto. 51-1

The Quebec Streams Commission

Proposed Bridge on the River Sauvage at Lambton, County Frontenac, P. Q.

Notice to Contractors

Sealed tenders, addressed to the undersigned, and marked "Tenders for a bridge over the Sauvage River," will be received at the office of the Quebec Streams Commission, Room 125, Parliament Buildings, Quebec, until twelve o'clock on **Tuesday, the 11th day of January, 1916.**

These tenders shall be for the following items:

(A) Tender for a wooden bridge, wooden piers and abutments and bridge approaches.

(B) Tender for Concrete Piers and Abutments and Bridge approaches.

(C) Tender for Steel Superstructure of Bridge.

(D) Tender for Items B and C combined, viz.: Concrete Substructure and Steel Superstructure.

Any tenderer may submit prices for one or all of the above items.

Plans and specifications can be seen after this date in the office of the Chief Engineer of the Quebec Streams Commission, Room 803 McGill Building, Montreal.

Parties tendering will be required to accept the fair wages schedule prepared or to be prepared by the Department of Labor of the Province of Quebec, which schedule will form part of the contract.

Tenderers are notified that tenders will not be considered unless made strictly in accordance with the printed forms.

An accepted bank cheque for a sum as mentioned below made payable to the Hon. the Provincial Treasurer, must accompany each tender, which sum will be forfeited should the party tendering decline to enter contract for the work, at the rate stated in the offer submitted.

Item "A" cheque for $2,500.00.
Item "B" cheque for $4,000.00.
Item "C" cheque for $3,000.00.
Item "D" cheque for $7,000.00.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security for the due fulfilment of the contract to be entered into.

The lowest or any tender will not necessarily be accepted.

By Order,
L. H. CHARLEBOIS,
Secretary.

The Quebec Streams Commission,
Montreal, December 23rd, 1915.

Unauthorized publication of this advertisement will not be paid for. 52-1

Tenders for

STREET CARS

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon, on **Tuesday, February 1st, 1916,** for the supply and delivery of:—

	Tender Numbers
Street Cars, Complete	70
Street Car Bodies	70-A
Street Car Trucks	70-B
Street Car Motor Equipment	70-C
Street Car Air Brake Equipment	70-D
Copper Cables for Street Car Work	70-E
Street Car Fare Boxes	70-F

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman, Board of Control.

Toronto, December 30th, 1915. 1

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Temporary Postal Station 'A,' Toronto, Ont.," will be received at this office until 4 p.m. on **Monday, January 10, 1916,** for the construction of the building mentioned.

Plans, specification and form of contract can be seen and forms of tenders obtained at the office of Mr. Thos. A. Hastings, Clerk of Works, Postal Station "F," Yonge Street, Toronto, Ont., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, December 29, 1915

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 1

Concrete Mixers

Large company in Middle States making concrete mixers wants selling agents for Canadian territory. Good working arrangement and substantial assistance will be given to reliable aggressive agents. Box 279, Contract Record, Toronto, Ont. 1-4

Quarry Machinery Wanted

Two gang saws and one planer in good working order.

F. ROGERS & COMPANY,
1193 Queen Street West,
Toronto, Ont.
1-2

Late News Items

Avonbank, Ont.
Plans are being prepared for a residence to be erected for A. Ready. Red pressed brick construction, concrete foundation. Approximate cost, $3,500.

Frome, Ont.
Robert S. Chute has decided to erect a barn and other outbuildings to replace those recently destroyed by fire.

Maisonneuve, Que.
J. A. Coulcombe, 134 Stadacona Street, has commenced the erection of three flats on Pie IX. Street, estimated to cost $7,000. Some of the smaller trades will be let. Stone and brick construction, felt and gravel roofing.

Muirkirk, Ont.
The erection of a school is being considered by the School Board. Approximate cost, $5,000. Trustee, P. A. McKellar.

Niagara Falls Centre, Ont.
W. C. Pretty, 751 Ferry Street, will receive tenders until January 6th for all trades except plumbing required in the erection of a residence and garage on Ferry Street. The contract for plumbing has been awarded to Payne & Nesbitt, 122 Main Street.

Portage la Prairie, Man.
The Public School in the East Ward has been totally destroyed by fire. Loss, $30,000; insurance, $18,000. Chairman of the Public School Board, R. H. Home.

Quebec, Que.
Plans are being prepared for a bank building to be erected on Ste. Foye Road for the National Bank, 75 St. Peter Street. Architect, P. Levesque, 115 St. John Street. Brick construction, concrete foundation, metal roofing. Estimated cost, $5,000.

Renwick, Ont.
H. DeClereck is considering the erection of a residence to replace that recently destroyed by fire. Estimated cost, $3,000.

Sexsmith, Ont.
Robert Tinney, Sexsmith, Exeter, Ont., is preparing plans for remodelling his barns and the construction of stables beneath them.

ESTABLISHED 1886

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Vol. 30 January 12, 1916 No. 2

Principal Contents

Better Design of Reinforced Concrete

WITH the increasing demand for reinforced concrete in all fields of structural endeavor the necessity for a fuller and more accurate knowledge of the stresses in beams and columns of different design is at once evident. Mr. M. T. Cantell covers in his paper on Reinforced Concrete the necessity for better designing in reinforcing to secure the greatest strength in concrete members and at the same time effect the strictest economy. The article, printed on other pages of this issue, briefly covers the merits of concrete as a compression member, steel as a tension member, and the benefits derived by effecting a combination of the two. Concrete has a crushing strength when a month old of upwards of 2,500 lbs. per square inch. This increases with age. In tension, however, its ultimate resistance is about 200 lbs. per square inch, while steel ranges from 60,000 to 100,000 lbs. per square inch, but diminishes with age due to oxidation by exposure to moisture, acids, and atmospheric conditions.

In reinforced concrete, properly designed and made, these two materials act together as one, with the advantages of both and the disadvantages of neither. Consequently, we have the strength, toughness, and rigidity of steel, the appearance of stability and strength, the steel permanently insulated from oxidation, no loss from age, a saving in the cost of construction, speedy erection, very little or no maintenance charge, and a material adaptable to all forms of architectural and structural work. Of the valuable properties of the work, few will exist if the work is not properly designed and executed. In designing, strength is considered the chief point. Strength, however, should be considered with economy. An economical structure would have a certain arrangement of beams, slabs, columns, etc., all spaced and proportioned in the most efficient manner, with a definite percentage of reinforcement, all determined with regard to the loading, with a view to obtaining the strongest, most satisfactory, and cheapest structure.

For economical structures the most important factors to consider are—the ratio of depth to breadth of beams, the percentage of reinforcement, and the general layout of beams and columns. For rectangular beams the most economical section is the ratio of 1 to 3 breadth to depth. The utmost attention should be paid to the percentage of reinforcement as great waste is often occasioned through an excess of steel being used. The fundamental principles underlying beam design should be carefully studied, the chief factor concerned being the neutral axis of the beam and what governs its position. Knowing this, it is only a simple mathematical problem to design a formula whereby we can determine the section of the beam that will contain sufficient concrete above the axis to take the compression, and the percentage of reinforcement necessary to develop the required stresses. The nature of the materials is a very important consideration. Portland cement of standard specifications, with mild steel reinforcement, should be used. Carbon steel should not be used, as its yield point is not so reliable as mild steel.

Sewage Disposal by Dilution

THE subject of Sewage Disposal by Dilution, on which much evidence has been collected by the British Royal Commission on Sewage Disposal, is most concisely stated and clearly described by Dr. W. E. Adeney in a paper before the Institute of Sanitary Engineers, England, which is printed elsewhere in this issue. It has been established in this Commission's investigations what amount of normal crude sewage—that is, liquid refuse containing organic matter in solution and suspension, and which is purifiable without previous treatment by living organisms—when discharged into a stream of known volume and velocity, under specified conditions, will not be detrimental to fish life or interfere with any other of the little amenities of the stream. Normal sewage discharged into a stream absorbs more or less rapidly the atmospheric oxygen dissolved in the water. This bio-chemical change between the dissolved oxygen and certain constituents of the sewage matter is brought about by two classes of water bacteria, one class feeding upon the waste organic constituents, and the other, a nitrifying bacteria, upon the ammoniacal constituents contained. The method of nutrition is very dissimilar to any other form of life, vegetable or animal. Water bacteria obtain the energy necessary to carry on their vital processes from oxidation of their own food rather than from the oxidation of any portion of their own substance. When amply supplied with dissolved oxygen they will convert upwards of ninety-five per cent. of the fermentable constituents of the sewage liquid in the polluted water into CO_2, nitrates, and humus, leave no product of their own action, and, when dead, constitute favorable food for green vegetable growths and other forms of life.

The quantity of dissolved oxygen available in the diluting water must be ample to fully oxidize the organic impurities in the sewage effluent and still leave sufficient to support fish life. When the sewage liquor discharged into a stream is in excess of what the dissolved oxygen in its waters will take care of, the bacteria flourish in such great numbers, owing to the surplus supply of food materials, that they absorb the dissolved oxygen more rapidly than it can be replenished by the absorption of fresh oxygen from the air, the result being that the water becomes de-oxygenated and is unable to support fish and other forms of life. The amount of sewage liquor which can be discharged into a stream therefore depends upon the quantity of oxygen dissolved in the waters of the stream, and it is plain that, if no ill-effects are to result, the dissolved oxygen in the mixed sewage liquor must be in excess of the amount necessary to combine with the fermentable constituents of the polluting liquid. Regarding the discharge of crude sewage, where the solids cannot easily be broken up and adequately supplied with dissolved oxygen during any fermentative changes exerted upon them by the water-bacteria, the stream must be of such a character that the solids can be transported and dispersed over large areas of clean bed; otherwise the solids deposit and become offensive.

Summed up, given a clean stream of sufficient volume and transporting power and a limited amount of pollution, the waters of the stream will become self-purifying, and no harm would result in non-potable waters.

Montreal Rejects Advice of C. S. C. E.

As predicted, the Montreal Council have rejected, by 22 to 7, the request of the Canadian Society of Civil Engineers that a board of independent engineers be appointed to report on the improvements to the city aqueduct, particularly the plans for a hydro-electric development for power and light. Alderman L. A. Lapointe, who favors the investigation, asked that a board of engineers submit a complete report and make such suggestions as they might deem advisable. He argued that power could be obtained from private companies at a smaller cost than under the civic scheme; in his opinion the cost of the scheme would be prohibitive. Controller Cote defended the plans on the ground that objections should have been taken in 1913 when the scheme was first authorized. He contended that the plans had been approved by competent engineers, with the exception of the large power house which would at a later date be laid before qualified engineers. The opposition came, he said, from electric companies, who might in the future form a trust and attempt to squeeze the city, and the city should therefore be prepared to do its own lighting. Mr. Cote claimed that the work should be proceeded with as soon as possible and if the Council adopted the report made by the Board of Control to arrange for the necessary loans, in the early spring the construction company would be in a position to start work again right away.

The council passed by-laws authorizing the raising of loans of $1,500,000, $680,000 and $500,000. The first loan will supply funds for the construction of the power house for the hydro-electric development, a wall for the enlarged aqueduct, two bridges, gates at the intake, etc.; the second loan is to continue the work of enlarging the aqueduct; and the third loan is for the cost of expropriations of land in connection with the proposed boulevards and streets on each side of the aqueduct.

With regard to Controller Cote's statement that the plans have been approved by competent engineers, it is the contention of the Council of the Canadian Society of Civil Engineers that while several engineers have reported on sections of the scheme, no outside engineers have reported on the complete scheme as it exists to-day, and that the original plans have been so altered as to make it imperative that a report on the whole project should be made by independent authorities. Further, it is certain the cost of the hydro-electric development will be very excessive, much higher than installations owned by private companies, while the citizens will also be burdened by an extravagant capital cost and by annual charges which make the generation of the 10,000 horse power an uneconomic proposition. The necessary power can be purchased at a smaller cost from the existing companies, and there is no justification for piling up expenditure on citizens already heavily taxed for much unproductive outlay.

Probable Life of Steel Bridges

The probable life of a steel bridge is a point of serious consideration, if this type of construction is to be generally used. The life of the steelwork will depend almost entirely upon the attention it receives from the maintenance forces. If properly painted with a good quality of paint there is no apparent reason why the life of a well designed steel bridge may not be very great. From observation of properly painted steelwork it is believed that under ordinary conditions our present riveted steel structure or I-beam spans should have a life equal to, if not greater than, much of our present concrete construction. To attain a life of even twenty years the steelwork must often receive attention, and corrosion must be checked before it seriously affects the metal. With the general tendency towards more efficient supervision of highway work we are able to provide greater assurance of prolonged life to our metal structures in the matter of keeping them properly painted and in repair. The elimination of details not easily accessible for painting, and the demand for more durable paints, have both tended to increase the general use of steel structures. The annual depreciation and maintenance charge need not be high if the steel receives the proper shop and field coats before erection, and if it is given the necessary attention after erection.—From a paper by J. H. Ames, Northwestern Road Congress, Cedar Rapids, Iowa.

New Deep Water Terminals at Halifax

Largest harbor work in progress in America 2,000 ft. of landing quay, six piers and berths — Unusual methods of quay wall construction

The Dominion of Canada, through its Department of Railways and Canals, is now engaged at Halifax, Nova Scotia, in the construction of one of the largest port developments in the world—a development which comprises not only an entirely new location of the ocean terminals of a port now over 150 years old, but also the radical revision of the railway entrance to the city. The scheme is of much more than local, or even provincial importance, inasmuch as it is part of the transcontinental railway enlargements fathered by the Dominion Government, and a bid for the transatlantic trade centering not only around interior Canada, but the great northwest section of the United States. Started in 1913, it has been consistently carried forward even during the financial stress of the past year, and has now reached a substantial advance in actual construction. Contracts already let total over $7,000,000. It is estimated that the finished scheme will cost four times that amount. The city of Halifax is located on the east coast of that peninsula, in a harbor of exceptional natural advantages. Direct passage is offered ocean steamers from the open sea through a wide bay entrance to deep-water berths protected from the force of wind and waves and faced by a basin of ample space for maneuvering. Although quite far north, it is ice-free the year round. Furthermore, it is the port in North America nearest to Europe. Its location on the continent is not so advantageous, inasmuch as while it is on the Nova Scotia peninsula, "the long wharf of Canada," all railway connections must go north to the neck of that peninsula to reach the mainland. It has, however, an old established railway which is tied up to the various Canadian transcontinental lines.

The city was founded in 1759 and had only a provincial importance until the beginning of the railway era, when for a time it promised to monopolize the trade of eastern Canada. The more orderly development of other Atlantic and St. Lawrence ports, and particularly their greater attention to trans-shipment and transportation necessities, soon caused them to surpass Halifax, and for many years it progressed but little as a port.

The defect at Halifax lay in poor railway connections, and more especially in inadequate and faultily located terminals. The main part of the city is situated on the east shore, about midway down a peninsula about five miles long and two miles broad, making out into the bay. This peninsula, particularly the northern section, rises rather abruptly from the shore, the rise continuing back to the neck. In consequence the early railway builders took advantage of the low level on the bay shore to bring the tracks to a point about half way down the shore line. Since the construction of the road, over fifty years ago, the city has grown southward, so that at present the centre of business is a long way from the terminals, and, more important, the shore south of the terminal has become crowded with private wharves, warehouses and factories, the removal of which to permit a southerly extension of the railway would be most costly.

For many years the ocean terminals have been in the congested districts just south of the railway passenger station, and in 1910, in an effort to improve conditions, the government undertook the reconstruction of this section, starting with the building of the large reinforced-concrete pier No. 2. It was felt, however, that such provisions were only makeshifts and that some radical revision of the whole harbor must be made if the port were to be developed to meet the national needs anticipated in the Canadian transcontinental and trans-oceanic trade expansion consequent on the rapid development of this vast country. To provide for this expansion the Intercolonial Railway has been greatly improved and will be double-tracked with revised grades from Moncton to Halifax.

The Intercolonial Railway now entering Halifax and its connecting line, the National Transcontinental Railway, both of which are under government control, form a continuous line from Halifax to Winnipeg under one management. At the same time the privately-owned railways of Canada are being extended with vigor. It has therefore naturally become a part of the Dominion's economic policy to develop an entirely Canadian control of the expanding trade between its people and Europe and to supplant the present partial control of existing trade by United States railways and

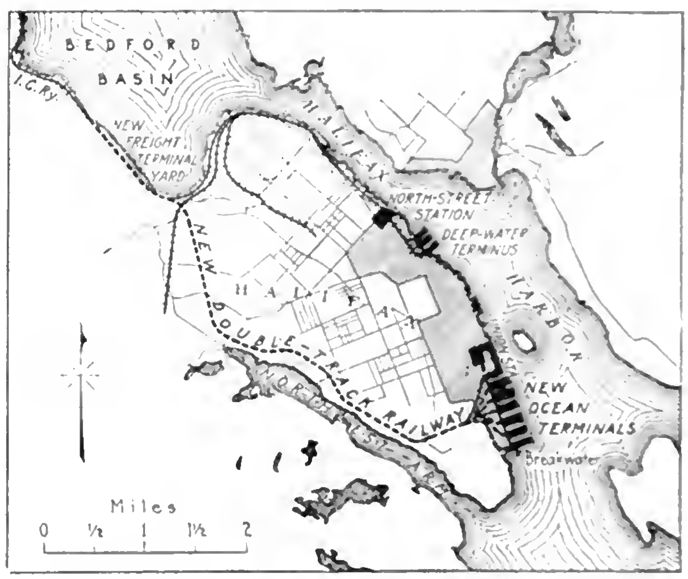


Fig. 1.—Map showing New Ocean Terminals at Halifax, N.S.

ports, dictated entirely by present superior economic advantages.

Halifax seems to have at least three dominant advantages to further this policy. It is the nearest port to Europe open all the year round and at all times, and should therefore be most desirable for transatlantic mail and passenger routes. It is a safe and easily accessible summer and winter port for Canada, thereby differing from the St. Lawrence cities. It is an all-year port of call for shipping between Europe and North America. The last-cited circumstance is considered a most important factor, as it promises to guarantee a sure and constant outlet to trade even though the port is not established as a terminal. The accepted path of transoceanic steamers bound for

* Engineering News.

United States ports would be lengthened only from twenty to fifty miles in calling at Halifax.

As a result of these considerations the government in 1912 decided to establish at Halifax a new deep-water terminal which should furnish safe and accessible landing facilities for vessels of the largest and most modern type and communicating railway terminals for passengers and freight located in the most desirable situation with regard to city population and industries.

An extended study of the harbor was made and designs were outlined at four different places—two makes its new detour back of the city, is to be built a large freight yard. A depth of 45 feet of water is to be provided at all berths except two which will have 30 and 35 feet respectively.

The whole project, from freight yard to terminal, is in territory not now in commercial use, so that business can be transferred from the old to the new location without interference or delay. At present only the railway connection, the landing quay, Pier A and the breakwater are under construction. In immediate prospect, however, is the erection of an elaborate terminal building which will house under one roof the re-

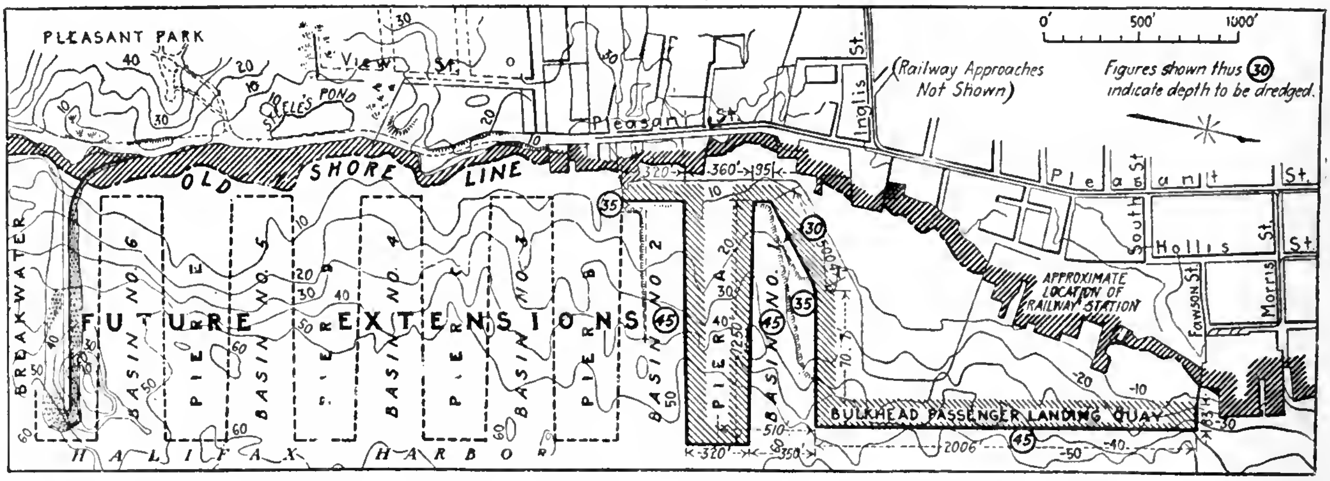


Fig. 2.—Halifax Ocean Terminals—showing Layout of Quay and Piers and location of Railway Station.

at Dartmouth on the opposite side of the bay, one an extension of the old terminals near the station, and one, which was adopted, near the south end of the peninsula. The Dartmouth schemes across the bay from Halifax were abandoned mainly because of the isolation of the sites, it being assumed from previous experience at other ports that it is difficult to establish new terminals removed from existing business centres. The extension of the present terminals was rejected largely because of the poor approaches along the narrow shore level and the expensive dislocation of the business district which would be required. The southerly plan was adopted because it did not have the disadvantages noted in the foregoing, and in addition, had several decided advantages, which can be enumerated as follows:

(1) A location convenient to the centre of the city; (2) utilization of a part of the city waterfront hitherto little developed, and largely unoccupied; (3) comparatively small effect on assessment value and taxation; (4) turning space in front of the terminals sufficiently large to permit the maneuvering of the largest ships; (5) convenience of the topography for a railway-terminal location; (6) sufficient depth of water to care for any ship now in existence or in contemplation; (7) room for a large freight yard; (8) possibility of extension at small cost.

The location of the new deep-water terminal is shown in Fig. 1 and the layout in Fig. 2. It consists of a landing quay 2,006 feet long and six piers with six berthing basins, all physically connected with a passenger and freight terminal approached by a double-track railway, which enters the city across the neck of the peninsula and connects with the piers through the point at the south end of the city. At the piers full equipment is to be provided in the way of warehouses, elevators and railway-terminal facilities, while on the shore of Bedford Basin, just before the railway quired facilities for steamship and railway-passenger service.

The total area to be used for the terminal will be about 260½ acres, of which 198½ will be land and 62 in water. The bulkhead landing quay, as stated, is 2,006 feet long, will have a minimum of 45 feet of water alongside and will carry for its full length a passenger and freight building, the ground floor of which is to be used for freight and the second floor for passengers, baggage, mail and express, connecting through a large concourse to the new Union passenger station for all the railways. On the north side of Basin No. 1 are berths for two ships, one 700 feet long, with a minimum depth of 35 feet of water, and the other 500 feet long with 30 feet of water, and each provided with double-storey freight sheds 100 feet wide, with three tracks at the back and one along the front of the quay. The five piers and basins, which have not as yet been started, will each be 1,250 feet long and each from 320 to 360 feet wide. The basins will be dredged to give a minimum depth of 45 feet at low-water level. There will be four berths to each pier and each berth will be provided with two-storey sheds and ample track connections. The layout of the station and terminal tracks is not yet complete.

At the extreme southern, or seaward, side of the piers a paved rubble-mound breakwater is being built along with the first unit of the docks. The breakwater will extend eastward from the shore into the harbor for a distance of about 1,500 feet, and will be built out to and upon an isolated ledge of rock which is at present in places very close to the surface of the water. When required by demands of business, a quay wall can be built along the inner side of the breakwater, which will itself then compose the centering for a new pier.

The landing quay and the piers are to be of earth and rock fill behind concrete walls of novel construction. The design was selected after careful study of the requirements, which may be outlined as follows:

(1) The great depth of water (45 ft.) to be provided at low water; (2) the varying levels of the present bottom of the harbor, particularly of the rock surface; (3) the dip in the strata and the irregular nature of the rock and its broken and laminated character; (4) the impracticability of cofferdamming on account of the exposure, great depth of water and danger of leakage through the rock; (5) the effect of the frequent ground swell and wind and waves on any staging and floating plants, difficulty in securing good bottom for piles and anchors, great length of spuds required for dredging with scows and the regulation of the plant to the rise and fall of the tide; (6) the low range of the tide and consequent difficulty in securing bracing for either temporary or permanent works; (7) necessity for practically a vertical-face wall on a wharf to suit the modern midship section; (8) necessity for protecting the face of the walls against disintegration from frost or sea water and the action of ships; (9) avoidance of taking out any more rock from under water than is absolutely necessary and having to replace it with concrete; (10) reduction of diver and expensive subaqueous work to a minimum; (11) necessity for rapid construction.

Quay-Wall and Pier Construction

The quay-wall method of construction consists in placing on a prepared bottom, in 30 to 60 feet of water, stacks of hollow reinforced-concrete blocks fitting one on top of the other to form the required height and joined together laterally to form the continuous wall. After setting these blocks, their cells, which line up vertically, are to be completely filled with concrete for the first 5 feet and above that each stack is to have its face cells and the middle line of transverse cells filled with concrete, the remainder of the other cells to be filled with stone rip-rap and sand so that in effect the completed wall will be a retaining wall with a concrete base and a concrete face strengthened with solid counterforts. Topping the wall above low water will be a granite-faced wall in the intertidal space and up to and including the coping, as a protection against the frost and sea-water action which might damage the concrete. The shed and warehouse structure will have their forward columns supported directly on the wall and their rear columns on pedestals footing on concrete-pile clusters driven through the fill which will be placed after the wall is completed.

The advantages of this method are that all the concrete is mixed with fresh water, molded in air, and allowed thoroughly to mature before coming in contact with sea water and placed so that it will not be subject to frost action. The mass concrete that is deposited under water is placed under conditions as nearly ideal as possible. The design of the walls obviates the necessity of using expensive temporary staging or floating cranes. Expensive foundations for the front row of the shed column are unnecessary. Settlement, expansion and contraction are provided for by means of the short sections and the leeway afforded by the reinforced-concrete guides.

While cellular concrete blocks for subaqueous wall construction are not new, in no other work have they been developed to such magnitude as at Halifax, nor has the method of placing and filling them ever been used before. At the present over 1,100 out of the 3,634 blocks required have been cast and are in storage at the site (see Fig. 5), but the placing has only just started, the first block being swung into place on September 25. The method in which the blocks are intended to be laid—which in the limited practice so far offered has proved very successful—can be outlined. The process of laying is also sketched in Fig. 4.

Placing the Concrete Blocks in Wall

The details of a typical block are given in Fig. 3. As shown in the general elevation, this block is only typical of those in the main part of the shaft, there being special shapes and sizes for the base blocks and for the top blocks. The block shown, however, is sufficiently typical for the purposes of description. It is 31 feet wide, the width of the completed wall; 4 ft. high and 22 ft. long, and weighs 60 tons. It is reinforced not only against its loads as a part of the wall, but against handling stresses. The walls are solid except for the triangular openings shown, provided so as to insure a good bond with the fluid concrete placed in the cells, and also vertical circular

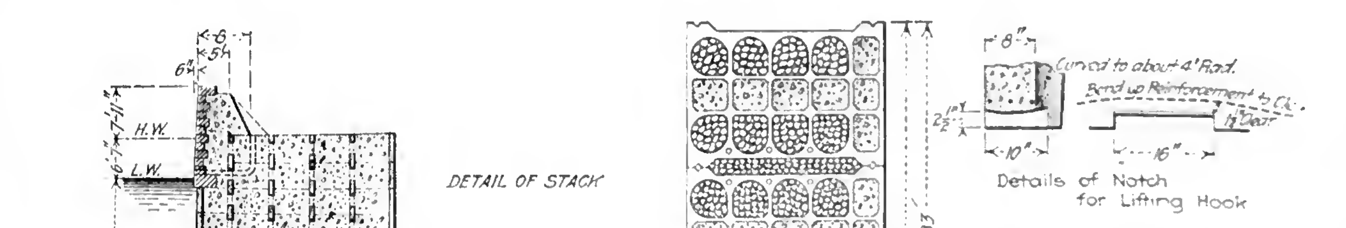


Fig. 3.—Details of the Concrete-Block Quay Wall 60-ton concrete blocks stacked up to form a 60 ft. wall.

openings for grouting, as afterward described. On each side are provided triangular vertical openings which serve as grooves to engage the square guide posts used in setting the blocks. These posts are in appearance the same as reinforced-concrete piles, and are cast in a similar manner. Great care is taken in getting plane surfaces and truly right-angled edges in the blocks, for upon these features depends the verticality of the finished wall.

The surface of the bottom, upon which the lowest block is laid, is prepared by dredging, or where already low, by filling up to the required grade with mass concrete or a rubble mound. The final levelling is made in the chamber of a diving bell. Inside of this bell the subsurface is cleaned up and where necessary at the back or front brought to proper elevation by filling holes or depressions with concrete, and then low concrete pedestals each about 5 x 6 ft. footing on solid rock, or concrete or rubble fill, are laid, with tops finished to true grade about 3 inches above the surrounding bottom. These pedestals are located at back and front at the junctions of stacks of blocks. The first block is then picked up with special tongs slung from a travelling crane, the jaws of the tongs fitting into specially prepared openings in the bottom of the block. With the crane running on a standard gauge track and standing with outriggers set on an already completed stack (see Fig. 4), the block is lowered overboard, effort being made to keep it lightly engaged against the vertical guide posts which have been plumbed and fastened into the corresponding grooves in the last stack already set. After the block is lowered to bearing on the pedestal, the succeeding blocks of the stack are placed until the stack is complete. The sealing concrete for the two bottom risers is then placed by bottom-dump buckets from a floating concrete mixer or delivered from the molding yard concrete mixer by flat cars running on the standard gauge track behind the crane, and then the filling of the proper cells with concrete to the top of the stack is completed. After this filling is finished, grout is forced into the vertical 10-in. holes, which,

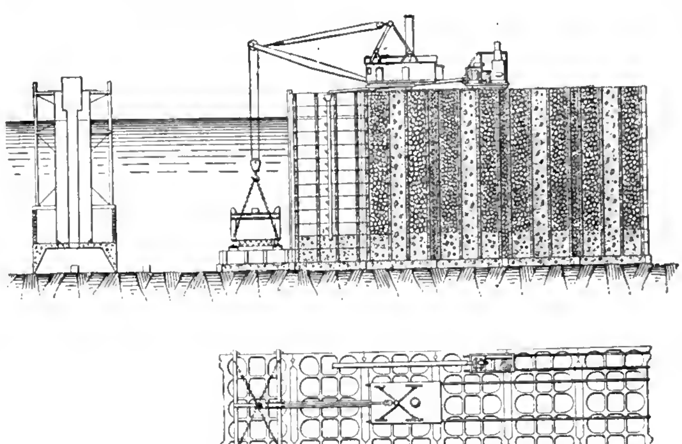


Fig. 4.—Method of laying blocks in the quay wall—Halifax Terminals.

matching up, form a continuous well through the stack. It is expected that this grouting will fill any voids left where the bearing of the blocks is not perfect or the concrete filling has left holes. Finally, the remaining cells are filled with rubble gravel and sand.

The placing of the blocks has from the first been attended with the greatest success. The guide and key posts which are carefully plumbed for each stack automatically bring the blocks into true position without the assistance of a diver whose services are required only for inspection and to see that all is clean and clear for the bottom blocks and mass concrete of each stack. No difficulty is found in keeping the stacks vertical or in securing good alignment. The tendency to "creep" longitudinally or to get out of line is corrected by using different combinations of the three standard sizes of posts provided. The variation in levels between the highest and lowest corners of the top blocks of the stacks as set does not

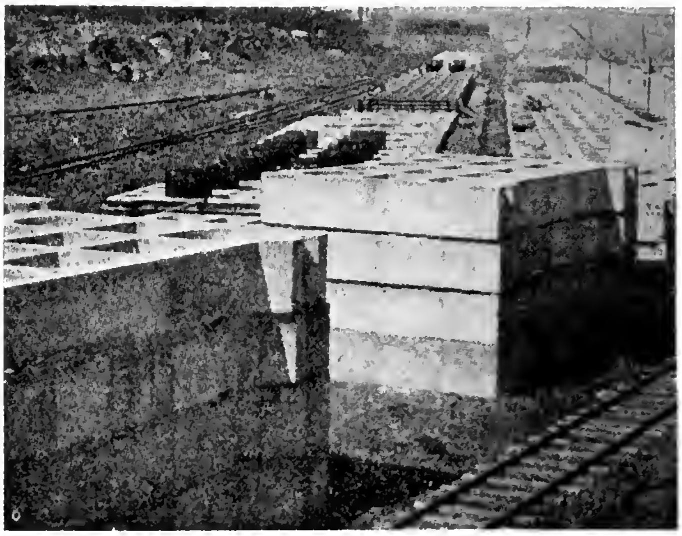


Fig. 5.—Hollow Concrete quay blocks in storage at Halifax.

average more than one-half inch. Blocks for about 500 feet of wall have already been set with a 150-ton standard-gauge steam locomotive wrecking crane which travels out on ordinary railway track laid on stringers resting on the stacks of empty blocks and extended by stack lengths of 22 feet as the block setting proceeds. The same crane is used for lifting the blocks from the molding platforms to standard flat cars on which the blocks are transported out to the wall head. As many as two stacks each of nine blocks have been set in one working day and an average per day of one stack of blocks loaded from the yard and set in the wall is easily maintained.

As the map in Fig. 1 shows, the new railway entrance leaves the old main line at the lower end of Bedford Basin and continues down the west side of the city to the terminals, a distance of about six miles. Except for the freight yard along the shore of the Basin and the four-track approach to the terminal yards, the line will be two-track. On account of the topography and the short length of the new line, it was impossible to balance the cuts and fills, so most of the work is in cut, the spoil being carried north to make the freight yard and south to the breakwater and back fill of the quay and pier walls. The total excavation is about 1¾ million cubic yards and the deepest cut about 60 feet.

Some difficulty was experienced in locating the line because the Northwest Arm, along which it runs, is a beautifully wooded section highly desirable as a residential, park and recreation district. On this account the line was kept well back from the water, and all crossings of streets leading to the water side district are to be carried above grade on handsome reinforced concrete arch bridges.

The landing quay and piers were located to fit as

(Continued on page 40.)

Mineral Productions of Canada, 1914

Some interesting figures covering mining, reduction and refining—Exports and imports—Coal still ranks highest in Value

The Department of Mines, Ottawa—Eugene Haanel, Director—have just issued three advanced chapters of the Annual Report on the Mineral Production of Canada during the calendar year 1914. The table herewith is a short summary of the production, exports, and imports of the various minerals. By "production" is meant the tonnage actually sold as used apart from the term "output" as applied to that total supplied at the mine, which includes loss due to unsaleable material, or stock on hand at the end of the year.

Pig-Iron and Steel

The iron and steel industry in Canada in 1914 was marked by a general decrease in production. The war in August caused an almost immediate collapse of the declining industry. Before the close of the year, however, the demand for steel for munitions and war supplies enabled many of the steel companies to resume operations on a large scale. At the beginning of the present year (1916) the steel industries are actually booming.

The making of iron and steel in Canada is an industry which has been built up largely on the basis of imported ores. The output has increased very rapidly from 1909 to 1913, but through the lack of demand fell off very considerably in 1914. At the close of that year Canada had twenty-two completed blast furnaces, grouped in twelve separate completed plants owned by nine companies or corporations. Eleven of these were idle during the year 1914.

The classification of the coke iron produced in 1914, according to the purpose for which it was intended, was—Bessemer, 230,817 tons; basic, 614,845 tons; foundry, including miscellaneous, 224,741 tons. Previous to 1896 pig-iron was made entirely from Canadian ores. Since that date, however, increasing quantities of imported ore have been used as well as imported fuels and fluxes, and in 1914 about 88 per cent. of the ore charged, 64 per cent. of the coke, and a large proportion of the limestone, were imported. The imported ores used in Canadian furnaces came chiefly from Newfoundland and the iron ranges south of Lake Superior.

Ferro Products

Ferro-silicon and ferro-phosphorus products were produced in Canada in electric smelting plants during 1914, the latter in small quantities only. Ferro-silicon, both 50 and 75 per cent., were made at Welland, Ont., by the Electro-Metals, Limited, and ferro-phosphorus, or phosphate of iron, at Buckingham, Que., by the Electric Reduction Company, Limited.

Steel was produced in 1914 in the following proportions: open hearth ingots, 622,097 tons; Bessemer ingots, 175,244 tons; direct open hearth castings, 15,315 tons; and other steel castings, 1,759 tons. The production of rolled iron and steel amounted to—rails, 382,344 tons; structural shapes and wire rods, 59,050 tons; plates, sheets and bars, 218,125 tons. Since 1896 a total of $16,785,827 has been paid by the government of Canada in bounties for the production of iron and steel.

The exports of iron and steel from Canada consist chiefly of manufactured goods such as agricultural implements, automobiles, bicycles, machinery, etc., and amounted to $14,391,746, in 1914. The imports of iron and steel, a large proportion of which come from the United States, consist mainly of pig-iron, Ferro products and chrome steel ingots, scrap, plates, sheets, bars, rods, sheet-iron and steel, pipes, nails, wire, etc., to the amount of $79,762,262, in 1914.

Coal

The coal production in 1914 was 13,637,529 tons, produced by 221 operating companies, employing an average of 27,571 men. The total consumption of coal in 1914 in Canada amounted to 26,852,323 tons, or 3,325 tons per capita. Almost all kinds of coal are produced in Canada. Bituminous coal constitutes by far the largest proportion of the annual production. Lignite only is produced in Saskatchewan, and in Alberta it forms a large proportion of that province's production. Of anthracite there is an almost negligible amount—less than 200,000 tons annually from one mine at Bankhead, Alberta.

Nova Scotia produces 54.77 per cent. of the Canadian coal, with Alberta next with 27.01 per cent., B. B. 16.42 per cent., Saskatchewan, 1.70 per cent., and Yukon 0.10 per cent.

The fact that the populous provinces of Quebec and Ontario have no coal-fields, and can secure most of their required amount more cheaply from the coal-fields of Pennsylvania, Ohio, and Virginia than from the Canadian coal-fields, accounts for Canadian imports exceedings 50 per cent. of Canada's annual consumption.

Coke

Both domestic and imported coal is used in the manufacture of coke in Canadian coke-ovens. In 1914 1,038,235 tons of domestic coal and 503,312 tons of imported coal were used to produce an output of 1,015,253 tons of coke. The Canadian consumption of coke in 1914 was 1,509,068 tons; 553,046 tons were imported during that year.

For the first time in history, Ontario leads in coke production with 386,314 tons, all of which was produced by the Algoma Steel Corporation. The coke exports for 1914 were 67,838 tons, all from British Columbia. In 1914 the total coke-oven by-products recovered at Sydney were—5,714,172 gallons of tar, 8,577 tons of sulphate of ammonia.

Aluminium

No commercial ores of aluminium have yet been found in Canada. Aluminium is, however, made in extensive works at Shawinigan Falls, P. Q., from bauxite ores imported from France and the United States by the Northern Aluminum Company. Alumina is imported, refined and exported as aluminium.

Antimony

The silver-cobalt-nickel-arsecnides of Coleman and adjacent townships, more familiarly known as the Cobalt District, in the province of Ontario, are now the principal sources of the world's production of cobalt. The recovery of this metal in Canada has been in the form of cobalt oxide and mixed oxides of cobalt and nickel, produced by the smelters treating the above ores together with cobalt residues produced at the high-grade mill of the Nipissing Mining Company. While these residues have been chiefly exported, a portion has been shipped to the Canadian smelters producing cobalt oxide. Bounties amounting to $26,744.75 on cobalt oxide, and $10,280.28 on nickel oxide, were paid to the Canadian refineries in 1914.

Copper

The total production of copper in Canada in 1914, estimated on the basis of smelter recovery from ores treated, was 75,735,960 lbs With the exception of a small output of copper sulphate at Trail, B. C., the copper production of Canada is exported for refining. In 1914 British Columbia led in copper production with 41,219,202 lbs., Ontario second with 28,948,211 lbs., Quebec 4,201,497, Yukon 1,367,050. In British Columbia the principal producers were—Granby Consolidated Mining and Smelting Power, Limited; B. C. Copper Company, Limited; and the New Dominion Copper Company, Limited. In Ontario the chief companies are the Canadian Copper, Limited, and the Mond Nickel Company, Limited. The Ontario Government offers a bounty on copper over 95 per cent. pure metal, and on copper sulphate produced from ore mined and refined in the province. The main shipments of copper from the Yukon were from the Pueblo mines at White Horse.

Gold

The production of gold was made up in 1914 as follows—gold derived from alluvial workings, $5,687,-501, or 35.6 per cent.; gold obtained from crushing free milling quartz ores—that is, stamped mill bullion, $6,-051,968, or 37.9 per cent.; and gold obtained from ores and concentrates sent to the copper and lead smelters, $4,243,538, or 26.5 per cent.

Refined Metal—The Dominion Assay Office in Vancouver, operated in connection with this Department, receives, assays and purchases crude bullion, amalgam, nuggets, and dust, the resultant bullion being re-sold. The total quantity of bullion thus received during the twelve months ending December 31, 1914 was 163,523.61 ounces, being the weight after melting, valued at $2,029,251.31, after deducting office charges.

A refinery is in operation at the Royal Mint at Ottawa and shipments of gold have been received from various provinces.

There is but one other refinery in Canada producing fine gold; that of the Consolidated Mining and Smelting Co. of Canada, Limited, at Trail, B. C., where the gold is mainly recovered from the high grade silver-lead ores and the "dry" ores shipped to the smelter. Its annual output is given below.

Lead

Previous to 1904 lead ores mined in Canada were either exported as ore or smelted in Canadian furnaces and exported in the form of base bullion to be refined abroad. A lead refinery employing the Betts electrolytic process is in operation at Trail, B. C., at the smelter there, treating the base bullion produced by the lead blast furnaces. The production of lead has been mainly from British Columbia, with occasional small amounts from Ontario. In 1914 there were no shipments from Ontario, but a small production in the Yukon. Almost all of the lead ore mined in British Columbia is smelted and refined at Trail, B.C.

Mercury

There has been no production of mercury since 1897. The small production reported in 1895 and 1897 was derived from the deposits at the western end of Kamloops lake, B. C. These deposits consist of quartz veins containing pockets of cinnabar in a zone of decomposed Tertiary volcanic rocks.

Elsewhere in Canada mercury has been reported as occurring also in ores of the Cobalt district, and in the neighborhood of Field, B. C., and Sechart on the west coast of Vancouver island.

Molybdenum

The commercial production of molybdenum in Canada has been practically negligible, nevertheless the mineral has been found in numerous localities and in many of these in sufficient quantity to make its possible recovery a question of considerable interest, an interest which doubtless has been greatly stimulated by the high price which the ore, concentrated to 85 or 90 per cent. molybdenite (MoS_2), has commanded.

During 1913 and 1914 some work was done on a number of properties in Ontario, Quebec, and British Columbia.

Shipments were made during 1914 from Ontario and British Columbia. The Ontario shipments consisted of one-half ton of molybdenite hand picked from the ore, while from British Columbia 16 tons of ore were reported as shipped to Denver, Col., where it was concentrated, producing 2,814 pounds of concentrates for which 20 cents a pound was received. The total shipments in the form of molybdenite were 3,814 pounds valued at $2,063.

Nickel

The industry based on the mining and metallurgical treatment of the nickel-copper ores of the Sudbury district, Ontario, ranks among the most important of Canada. Not only is there a considerable production of copper but the nickel, which is the most important product, supplies a very large proportion of the world's consumption of the metal.

The production of nickel ore, very active during the first six months of 1914, was checked on the declaration of war. Towards the end of the year the output was greatly increased, due no doubt to the great demand for nickel for war supplies, so that the production in 1914 was but little less than that of 1913, when the production of ore and its reduction to a Bessemer matte was the highest on record.

There were mined in 1914, 1,000,364 tons of ore, and smelted 947,053 tons; from which were produced 46,396 tons of Bessemer matte, carrying approximately 22,759 tons of nickel and 14,448 tons of copper, the net value of the matte being $7,187,031. Thus, in 1914, the matte showed an increase in copper content and a falling off in nickel due to the great increase in production of ores by the Mond Nickel Co., and their reduction in the Coniston Smelter and the curtailment of the Canadian Copper Company's output of ores which are relatively lower in copper content.

The nickel-copper ore is reduced in smelters and converters to a Bessemer matte containing from 77 to 82 per cent. of the combined metals, having averaged for the past year 49.0 per cent. nickel and 31.1 per cent copper, against 52.7 per cent. nickel and 27.4 per cent. copper in 1913.

The companies engaged in mining and smelting nickel ores are: The Canadian Copper Company, subsidiary to the International Nickel Company, with smelter at Copper Cliff, Ontario, and refinery at Bayonne, New Jersey; the Mond Nickel Company, Conis-

MINERAL—	Production		Imports		Exports	
	Amount in tons	Value $	Amt. in tons	Value $	Amt. in tons	Value $
Iron Ore	241,854	542,041	1,147,108	2,387,358	135,451	320,974
Pig Iron	783,164	10,002,856	78,680	982,189	19,063	186,396
Ferro Products	7,524	178,355	22,117	519,485	4,865	285,221
Steel (Ingots, Castings)	811,415	...	882,626	79,762,262		14,201,746
Steel (Rolled Products)	802,658	...				
Coal	13,637,529	33,471,801	14,721,057	39,801,498	1,423,126	3,880,175
Coke	1,023,860	3,658,511	708,777	2,069,914	67,828	306,117
Aluminium	Nil	...	(a) 28,557,000 "	571,419	14,510,800 lbs	2,264,807
Antimony	Nil	...	694,150 lbs	57,715		
Cobalt Oxide	899,027 lbs.	571,710	...	...	...	
Nickel Oxide	392,512 "	34,883	...			
Mixed Oxides	2,079,001 "	79,895	...	...		
Copper	75,735,960 "	10,301,691	...	4,256,901	77,298,723 lbs	8,270,689
Gold	773,178 oz.	15,983,007	...	...	...	
Lead	36,337,765 lbs.	1,627,568	10,924	1,012,583	756,073 lbs	22,188
Mercury	Nil	...	204,229 lbs.	97,449		...
Nickel ore mined	1,000,361	...				
Nickle matte	45,517,937 lbs.	13,655,381	...	83,185	(b) 46,528,327 lbs	5,149,427
Platinum	Nil	...	...	79,614		...
Silver	28,449,821 oz.	15,593,630	...	...	...	(c) 15,584,813
Tin	Nil	...	...	2,023,300		...
Zinc	10,893	262,563	...	...	...	...

(a) Alumina imported for refining.
(b) Includes "old and scrap."
(c) Ore exported for refining.

Summarized Table showing Production of Canadian Ores, Exports and Imports in Minerals during the calendar year, 1914.

ton, of London, England, with smelter at Coniston, Ont., and refinery at Clydach, Swansea, Wales. The British America Nickel Corporation continued development work. The Alexo mine, on the Porcupine Branch of the Timiskaming and Northern Ontario Railway, was again a producer, shipping nickel-copper ore to the Mond smelter at Coniston.

Platinum

In past years the chief source of the platinum production of Canada was the placer gravels of British Columbia, principally in the Similkameen district. During 1913 operators in the Cariboo district of British Columbia report a recovery of 18 crude ounces of platinum valued at $489. More attention is being paid to the recovery of this metal especially in the Similkameen where it is proposed to re-work some of the old placers.

One or two companies operating in the Quesnel River district report small quantities of platinum with placer gold but the information is not sufficiently definite for record.

Silver

In 1914 the total production of silver, including that produced as bullion, and the metal estimated as recovered from ores sent to smelters or otherwise treated, was 28,449,821 fine ounces, valued at $15,593,630.

In Ontario ores from the Cobalt district are treated by:—The Coniagas Reduction Co., Thorold, Ont.; The Deloro Mining and Reduction Co., Deloro, Ont.; The Buffalo and Ontario Smelting and Refining Co., Kingston, Ont.; Dominion Refineries, Limited, North Bay, Ont.; Standard Smelting and Refining Co., North Bay, Ont.; Metals Chemical Co., Welland, Ont.; Canada Refining and Smelting Co., Orillia, Ont.

Silver bullion of a fineness varying from 850 to 998.2 is produced at the works, other products being white arsenic, nickel and cobalt-oxides and mixed oxides. The silver bullion as a rule finds a market in the United States and in England. The bullion shipped from the mines and mills in the Cobalt district in 1914, is reported as 10,335,527 fine ounces. The imports of silver bullion into Canada in 1914 were valued at $629,279, as against imports to the value of $840,245 in 1913 and $1,100,344 in 1912. The exports of silver during 1914 were 28,020,089 fine ounces valued at $15,584,813.

Tin

Tin ores have not yet been found in sufficient quantities in Canada to be of economic importance.

Tungsten

No production of Tungsten reported during 1914.

Zinc

The production of zinc in Canada in 1914, as obtained by direct returns from producers, was 10,893 tons, valued at $262,563, the greater part being from British Columbia. The zinc content of these shipments was returned as 9,101,460 pounds, which, if valued at the average New York price of spelter during the year, 5.213 cents, would be worth $474,459.

Road-Making with India-Rubber

The use of India-rubber for road manufacture is reported by Sanitary Record and Municipal Engineering. Recently a firm of tar distillers in England got in touch with an India-rubber manufacturer with a view to producing a material which would combine all the properties of India-rubber with those of tar. After this rubber tar, as it is called, had been made for road-making and road-dressing purposes it was found that its high viscosity and melting point caused its application to roads too difficult. This has been overcome by the construction of special tanks to keep the rubber tar hot.

The advantages claimed for this type of road construction are the elasticity necessary to withstand the shocks from heavy vehicles, homogeneity and adhesion required to avoid disintegration by fast running vehicles. A length of road has been laid in Fife with this material, and although put down at an unfavorable time, is so far giving satisfaction, and further developments with it are being carefully watched by experts.

The Disposal of Sewage by Dilution

A bio-chemical method of purification—Effect of normal sewage on streams—Much depends on amount of oxygen dissolved in water

By W. E. Adeney D. Sc., F. I. C.*

A large volume of evidence has been accumulated of recent years by the Royal Commission on Sewage Disposal, and by a number of individual investigators, both at home and abroad, which has definitely proved that, when normal crude sewage matter is discharged into a non-tidal or tidal stream, under such conditions that the liquid portion is rapidly and largely diluted with "clean" water, and the solids in suspension are carried away with the flow of the stream, and are not allowed to accumulate permanently in any particular spot, both portions of sewage matter are consumed as food materials by various forms of living organisms, and converted into innocuous forms of matter, without causing at any time injury or detriment to the fish life or to the amenities of the stream.

Notwithstanding this evidence, however, much doubt and uncertainty still appears to exist among engineers and chemists as regards the precise conditions which must attend the discharge of sewage matter into a given stream to ensure the satisfactory disposal of the sewage matter, and to avoid undesirable results of any kind in the stream itself.

It may be fairly claimed that the chemical and biological principles which underlie the dilution method of purification have now been successfully worked out; and the writer proposes to give in the first place a brief explanation of them. They are fortunately very simple, and the experienced water engineer need have no hesitation in proceeding to tackle them.

Absorption of Dissolved Oxygen

Some years ago the writer concluded from the results that he had obtained from an extended experimental investigation that the most important effect that normal sewage matter exercises in a stream is the more or less rapid absorption of the atmospheric oxygen dissolved in the waters of the stream.

This conclusion has since been confirmed by the laborious and prolonged investigations that have been carried out by Dr. Houston, Dr. McGowan, Mr. Colin Frye, and Mr. Kershaw for the Royal Commission on Sewage Disposal; by the extensive series of observations carried out by Dr. Soper, president of the Metropolitan Sewerage Commission of New York, and by his assistant, in New York Harbour; and by the observations of other investigators, both at home and abroad, and notably in this country by Prof. Letts and his pupils in Belfast, and by Dr. Fowler and his pupils in Manchester.

The absorption of the dissolved oxygen is caused by bio-chemical changes which water bacteria, by reason of their quite unusual mode of nutrition, bring about between the dissolved oxygen and certain of the constituents of the sewage matter.

Two classes of bacteria take part in these changes. First, the saprophytic (Greek word sapros=rotten) bacteria feed upon the waste organic constituents of the sewage matter; and, secondly, after the organic constituents have been wholly consumed, the nitrifying bacteria feed upon the ammoniacal compounds.

*Before the Institute of Sanitary Engineers, England

Both these classes of bacteria flourish in the open—in fresh and in sea water; and they are therefore unlike in this particular the disease-producing bacteria, which are always parasitic and cannot live in open water.

The chemical changes which these bacteria effect in polluted waters may be conveniently termed fermentative or bio-chemical changes, to distinguish them from those purely chemical changes which occur between bodies that exhibit direct chemical affinity for one another when they become mixed together.

Practice of the Dilution Method

Saprophytic bacteria can utilise the dissolved and solid suspended organic constituent of sewage matter as food materials, but in the practice of the dilution method, for reasons which will become plain later on, it must be the aim of the engineer to allow as little opportunity as possible for the solid constituents of sewage matter to be attacked by the water bacteria. The physical conditions of the stream must be such as to ensure their consumption by living organisms higher in the scale of life than bacteria if they are to be discharged into it. Otherwise they must not be allowed in the stream.

It is necessary therefore to consider the question of the disposal of the liquid portion of sewage matter separately from that of the disposal of the solid portions, and it will be convenient to deal with it first.

It is possible by suitable experiments to trace the chemical changes that occur in a diluted sewage liquor, simultaneously with the absorption of dissolved oxygen in the diluting water, and it has been found that in all cases where the dissolved oxygen is in excess of the sewage liquor the chemical decomposition of the latter takes place in two quite distinct and progressive stages of chemical change.

During the first stage, as already indicated, the organic constituents are alone affected—about 80 per cent. of them are completely oxidised to carbon dioxide, water and ammonia, the remaining 20 per cent. being utilised by the bacteria in building up the new materials that they require for their growth and multiplication. But, inasmuch as these building up, or, as the chemist terms them, these synthetic processes, are exercised upon organic materials of complicated composition, it will readily be understood that by-products must also result from them.

These by-products are coloured organic substances, remaining in solution, or rather in a colloidal condition in fresh water, and imparting a greenish yellow to brown tint to the water, according to the quantity of sewage liquor originally mixed with it. They are precisely similar in their physical and chemical properties to the "humus" of cultivated soils.

In the case of sea water, however, these humus bodies do not remain in solution, or suspended in it in a colloidal state, but are precipitated from it more or less rapidly as they are formed.

Thus, by the action of saprophytic bacteria upon the dissolved organic constituents of the sewage liquor, when amply supplied with dissolved oxygen, about 80 per cent. are completely oxidised to the min eral forms of matter—carbon dioxide, water and ammonia; and of the remainder, much the greater part—upwards of 15 per cent—are converted into "humus," also a mineralised form of matter; while less than 5 per cent. go to form the substances of the new bacteria.

After the bio-chemical destruction of the organic constituents of the sewage liquor has been accomplished, the second stage of change is started, and in the course of time completed by the nitrifying bacteria. These bacteria feed upon the ammoniacal compounds originally present in the sewage matter, and also upon those formed during the first stage of fermentation. The "humus" matters, also formed during the first stage of fermentation, likewise exercise a very important influence on the course of fermentation of the ammoniacal compounds.

Thus, when they are absent from a water or present only in minute quantities, as in the case of sea water, relatively large quantities of nitrites, but little or no nitrates, are found among the end products of the fermentation; but when "humus" bodies are present, nitrites do not occur among the end products, only nitrates and carbon dioxide, together with, of course, dead organisms, the first being relatively large in quantity, the second small, and the last very small.

"Humus," as above stated, does not remain in solution, or suspended for any length of time in the colloidal state, in sea water; consequently in polluted tidal waters nitrites are formed to the exclusion of nitrates. This fact no doubt affords the explanation of the interesting observation made by Dr. Soper in the course of his investigations of the waters of New York Harbour. He has found that decided quantities of nitrites exist in these waters. The sewage from Greater New York is discharged practically in a crude state into the harbour, wherein the solids are deposited and the sewage liquor remains, largely diluted by the river and tidal waters in the same, for several days, and undergoes almost complete fermentation before being gradually carried out to sea by tidal action.

If the character of the bio-chemical changes which these two classes of water bacteria bring about in diluted sewage liquor, as just described, be carefully considered, it will be found that they are quite unusual when compared with the chemical changes which other organisms, higher in the scale of life, bring about in the course of their vital processes.

The mode of nutrition of these bacteria is, in fact, quite unlike that of any other form of life—vegetable or animal.

Mode of Nutrition

It is owing to this unusual mode of nutrition, as well as to their universal distribution, that the impossibility of including them in any scheme of general classification of animal and vegetable life is due.

Their peculiarity in this respect lies in the fact that they obtain the energy they require for carrying on their vital processes from the oxidation of their food materials, and not from the oxidation of any portion of their own substance. They also appear to utilise but a small portion of the energy which they set free in this way for the purpose of their own development and multiplication, unless rise of temperature in their surrounding medium be regarded as a factor involved in their development.

As a result of their peculiar mode of nutrition they convert when amply supplied with dissolved oxygen, the large proportion of upwards of 95 per cent. of the fermentable constituents of the sewage liquor in a polluted wated into the innocuous mineral forms of matter—carbon dioxide, nitrates and humus, and, unlike most animal forms of life, they leave no product of their own action, nor unchanged portion of the sewage that could in any way subsequently become offensive, or detrimental to the stream.

The dead bacteria which have flourished upon the sewage liquor, in common with all the other end products resulting from the fermentation of the sewage matter, form favourable food materials for green vegetable growths, and for other forms of life.

There is a further result which attends the peculiar mode of nutrition of water bacteria in the presence of an ample supply of dissolved oxygen, to which the attention of engineers may usefully be drawn, although perhaps it is of more interest to the chemist than to the engineer. It is that the quantities of dissolved oxygen absorbed, and of the end products formed, on the completion of each stage of fermentation, are constant for similar volumes of the same polluted water.

Bacteria as Scavengers

Such is the efficient and harmless manner, so far as the fish life and the amenities of a stream are concerned, in which bacteria act as scavengers in sewage-polluted waters, always provided that a relatively ample supply of dissolved oxygen remains in the water at all times.

When, however, the conditions are reversed, and the sewage liquor in a stream is in excess of the dissolved oxygen in its waters, the bacteria flourish on the increased supply of food materials in such great numbers that they absorb the dissolved oxygen more rapidly than it can be replenished by the absorption of fresh oxygen from the air.

The first consequence of this is—the oxygen content of the water falls below the minimum level required by the fish and other normal forms of life supported by the stream for the continuation of their vital processes. The bacteria, however, continue to feed and flourish on the sewage matter, and when the dissolved oxygen has been entirely exhausted they obtain, by the exercise of another marked peculiarity in their mode of nutrition, the oxygen which they require for the continuation of their vital processes—that is, by decomposing inorganic oxygen compounds such as nitrates and sulphates—that may be present in solution in the water. When both nitrates and sulphates are absent, then the required oxygen is obtained by the decomposition of organic oxygen compounds; in other words, anaerobic or putrefactive fermentation is set up by the bacteria in the fermentative organic constituents of the sewage matter.

When nitrates are thus robbed of their oxygen, the residual substances are quite odorless and innocuous, and the polluted water remains in consequence inoffensive to smell, although deoxygenated.

When, however, sulphates or organic substances are robbed of oxygen in this way, the residual substances in both cases emit offensive odor, so that the waters containing them are offensive to the smell and in appearance, as well as deoxygenated.

If sulphates are present in a water, sulphuretted hydrogen is produced, and this body forms with any iron compounds that may be present in the polluted water a black sulphide of iron—hence the black or discolored appearance of many highly polluted waters.

It may here be noted, in passing, that the sulphuretted hydrogen and the sulphide of iron thus formed and deoxygenated organic compounds possess the property of very rapidly reabsorbing oxygen when the polluted water containing them becomes mixed with "clean" water. It will be necessary to deal with this point more fully when the disposal of sewage solids comes to be considered. It will then be seen that it is one of great practical importance.

The amount of dilution with "clean" water which must be given to a sewage liquor to ensure the condition that the dissolved oxygen in the mixed liquor and "clean" water shall be in excess of the fermentable constituents of the liquor will depend upon the quantity of oxygen dissolved in the diluting water.

It is well to bear in mind in this connection that under atmospheric conditions unpolluted fresh water can hold only extremely small quantities of oxygen in solution, even when completely saturated at atmospheric pressure with that gas. Thus 100,000 c.c. of fresh water, when saturated with the gas at 60 deg. Fahr., and under ordinary atmospheric pressure, holds only 1 gramme of the gas in solution; while a similar volume of unpolluted sea water can hold still less—only 0.8 gramme—under like conditions.

The actual amount of dilution required by crude sewage, or by partially or by wholly purified sewage matter, has been investigated by the Sewage Commission, and their recommendations regarding the question have been published in their Eighth Report.

For sewage liquor—that is to say, for sewage from which the suspended solids have been removed by efficient sedimentation tanks—the commission recommend a dilution with from 300 to 500 volumes of water of a quality which they define by a certain standard chemical test, and which they term "clean" water.

Required Polution

In the case of a sewage liquor from which the suspended solids have been previously removed by chemical precipitation, they do not require so much dilution—only 150 to 300 volumes of "clean" water.

A sedimented sewage liquor would hold light fermentable organic solids, mostly in the colloidal condition, in suspension, as well as fermentable organic substances in solution; but its combined organic content of a fermentable character would not exceed on an average, 30 parts by weight per 100,000 parts of the liquor.

Hence, when such a liquor is diluted with 300 times its volume of "clean" water—the minimum dilution recommended by the Sewage Commission—the mixture would only contain about 1 part of fermentable organic material per 1,000,000 parts of water.

It is of great practical importance to the engineer to note that when sewage liquor is thus largely diluted, the absorption of dissolved oxygen from the diluting water proceeds at an extremely slow rate, so slowly, indeed, that, in order to detect it by means of a chemical test, a sample of the diluted liquor must be kept in a suitable vessel out of contact with air for several days. To be precise, the total loss of dissolved oxygen shown by a sample of sufficiently diluted sewage liquor, when kept out of contact with air for a period of five days at 65 deg. Fahr., will not exceed 0.4 gramme per 100,000 c.c. of the water.

The rate at which the dissolved oxygen would be replenished in the diluting water and sewage liquor by absorption of fresh oxygen from the air, when exposed to the natural conditions of the stream, would in the case of most rivers and inshore waters be at least equal to the rate of loss indicated by this analytical figure. Hence it may be concluded that, when the discharge of a sewage liquor into a "clean" water stream is properly controlled and limited, it should not, after it has been sufficiently diluted by the waters of the stream, cause an appreciable reduction of the oxygen content of the same waters.

Such, in brief, are the more important bio-chemical principles which underlie the dilution method of disposal for normal sewage liquor.

Disposal of Solid Matters

Adverting now to the question of the disposal of the solid portions of sewage matter, it will readily be understood that water bacteria cannot be relied upon to "mineralise" them when they are discharged into a stream in the same efficient and innocuous manner as they can be in the case of the sewage liquor, simply because these solid portions cannot in like manner be broken up and attenuated by the waters of the stream to anything like the extent of 1 part per 1,000,000, and cannot therefore be adequately supplied with dissolved oxygen during any fermentative change exerted upon them by water bacteria.

If the stream into which they are discharged be not sufficiently rapid to transport and to disperse them through large volumes of "clean" water or over large areas of clean bed, they will be deposited more or less rapidly along the bed; and if they remain there undisturbed for a few days, they will encourage the growth of myriads of water bacteria in and about their mass; and since their fermentable organic constituents would be in large excess of the dissolved oxygen in the water about them, they would undergo anaerobic fermentation, with the attendant formation, as above described. of the offensive gas, sulphuretted hydrogen, of the black sulphide of iron, and possibly also of offensive deoxygenated organic substances, the sulphuretted hydrogen and sulphide of iron being more largely formed in the case of sea waters than in that of non-tidal waters, inasmuch as sea waters hold larger quantities of sulphates in solution.

These products of anaerobic fermentation will tend to poison the bed of the stream in the immediate neighborhood of the deposited solids, and the extent of the injury would depend upon the area of bed covered by them. It is well to remember that comparatively small areas of solid deposits may, if disturbed from time to time, very distinctly reduce the oxygen content of large volumes of waters flowing over them. When, for example, the putrescent solids become disturbed and distributed through the water flowing over them by a freshet in a river after dry weather, or by a spring tide following a neap tide period, they would absorb in a few minutes more or less completely the dissolved oxygen of the water through which they were dispersed, owing to the great chemical affinity which the anaerobic products, above enumerated, possess for dissolved oxygen.

(Concluded in next issue)

The Benefits of Hydrated Lime in Concrete

It has been found in recent years that the judicious use of a small percentage of hydrated lime performs certain functions necessary to good concrete, such as segregation of the aggregates during placing, reducing shrinkage cracking to a minimum and making the concrete watertight, thereby reducing the expansion and contraction of the concrete, due to the absorption and expulsion of water. The use of from 5 to 15 per cent. of hydrated lime, (by weight of the cement ingredient), has been steadily growing in favor with engineers, architects and contractors.

A Factory Built on Concrete Piles

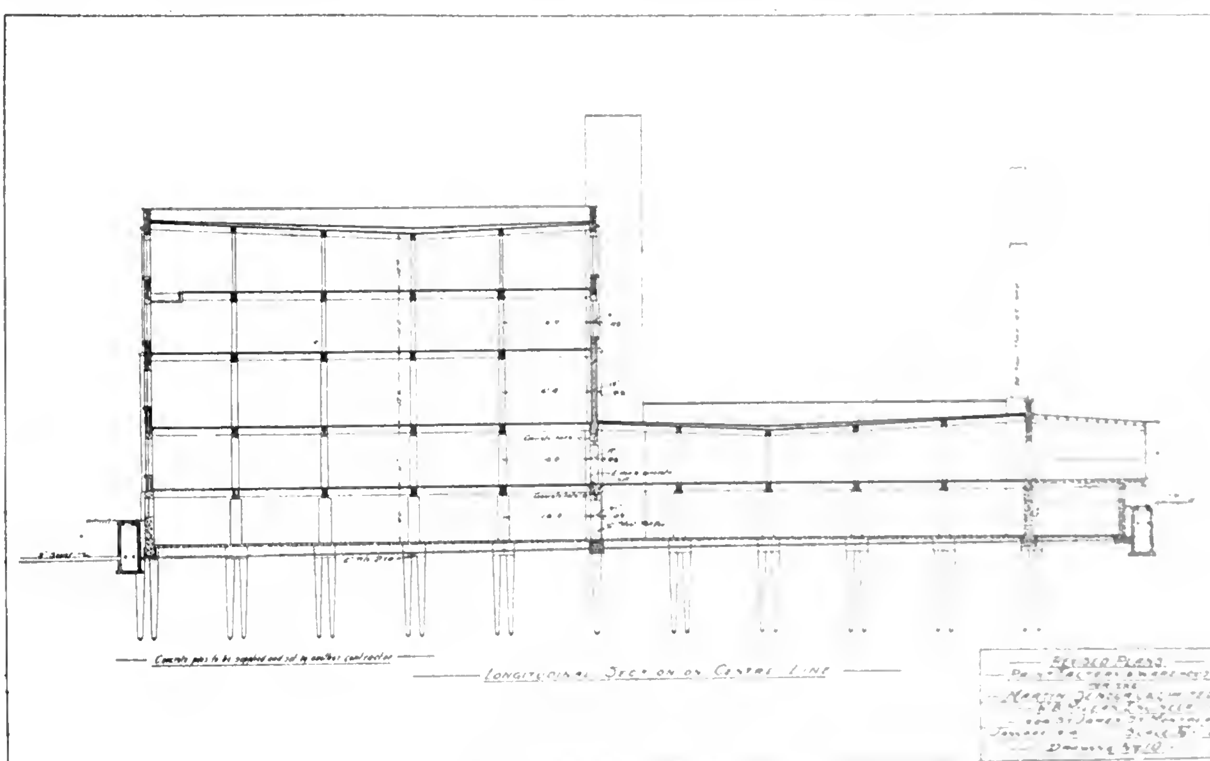
With a view to consolidating their manufacturing facilities the Martin-Senour Company, Limited, makers of paints and varnishes, have just completed a paint factory on a site adjoining their varnish factory at Park Avenue Extension, Montreal. The building is of heavy mill construction, specially designed by Mr. W. B. McLean, engineer, of Montreal, to meet the requirements of the company. The building is in two sections—one of four storeys and the bacement, and the other of one storey and basement, the former being used mainly for manufacturing and the latter for shipping and storage. It is intended later to build additional storage on the shipping and storage end, making the entire building four storeys high. What is now the outer wall up to the shipping room will then be a fireproof wall, from basement to roof, dividing the building into two portions. In plan the building is 180 feet by 80 feet.

Owing to the peculiar nature of the soil, it was necessary to sink about 400 piles for the foundation; this work was carried out by the Raymond Concrete Pile Company of Canada, Montreal. In addition the ground is underdrained, four catch basins, one at each end and one at each side, being constructed. To minimize fire losses and ensure the safety of the employees each floor is entirely separate, and can only be reached from a fireproof stair tower, protected by fire doors at every floor. In this way a fire in any of the departments would be confined to that room. The stairway is of concrete. The elevator runs in a heavy brick tower, also shut off by fire doors at each floor. This tower is extended above the roof to carry the sprinkler tank. The building is of plastic brick, with windows of steel. The floors are supported by beams of Douglas fir, with Duplex hangers and post caps. The roof was built to Barrett specifications. The building is also fitted with an efficient sprinkler system.

The basement is devoted to the storage of raw materials, which are delivered from the railway cars on a siding, the C. P. R. line running alongside the factory. The goods are placed on a covered concrete platform on the first floor level, and from there are lowered by means of a slide into the basement. Under this platform is a basement space which is outside of and separated from the main building. This is used for the boilers, coal pocket and large storage tanks for linseed oil. The oil is raised by air pressure to the upper floors of the factory as required. Putty mixing is carried on in another portion of the basement.

The raw material, after being lowered into the basement, is elevated to the top floor, where are situated the paste mixers; after this operation it is dropped direct into the grinders, which are directly underneath on the floor below. The next process is that of liquid mixing, done on the second floor, the material being lowered direct into the machines from the grinders. The liquid is afterwards pumped into a number of separate mixing tanks on the same floor, the second floor being of a greater height than the others on account of the larger size of the equipment. The paint is now run into separate containers, which are sealed and labelled ready for the storage bins on the first floor, to be shipped as called for. The other portion of the first floor contains the offices, printing room, and advertising department. Each department is operated by electricity, with a motor on every floor.

The general contractors were Messrs. Reid, MacGregor and Reid, Montreal. The heating was carried out by T. H. Higginson, Limited, Montreal, who also installed the sprinklers. Darling Bros., Montreal, were the contractors for the elevators, while the plumbing was done by Mr. John Date, Montreal.



Paint factory and warehouse—Martin-Senour Co., Limited, Montreal.

Better Design of Reinforced Concrete

To Obtain Strength, Toughness, Rigidity with Greatest Economy— Valuable properties lost if work is not properly designed and executed

By M. T. Cantell, Lic. R.I.B.A.*

Reinforced concrete is a combination of Portland Cement Concrete and Steel, two of the most important materials used for construction, which if used separately have each their advantages and disadvantages. If combined, of the right quality and properly proportioned, the resulting material will have the advantages of both and the disadvantages of neither.

Concrete alone has great strength in compression, its crushing resistance when a month old being approximately 2,500 lbs. per sq. inch. It is very durable in any position, is practically everlasting, costs nothing for maintenance and its strength increases with age, but it is of little value in tension, its ultimate resistance being about 200 lb. per sq. inch. It is a good material to resist heat, but it is not elastic or ductile, and owing to the lack of these properties and to its weakness under tension, it will quickly develop cracks in resisting the slightest contraction which takes place under variations of temperature. These cracks, however small, will destroy the slightest tensional resistance the concrete might otherwise offer. Consequently concrete alone can be used for such structures or parts of structures that are in compression, and this, in many cases, necessitates a very large mass of concrete, and consequently, a much greater weight and demand on space than is desirable. An obvious disadvantage of plain concrete is its great bulk and consequent weight and demand on space.

Ultimate Strength of Steel

In steel we have a material of great strength in both compression and tension, its ultimate resistance being as much as from 60,000 lb. to 100,000 lb. per sq. inch, but its strength diminishes with age. This is chiefly due to oxidation which takes place on exposure to moisture, acids or to atmospheric influence. This is very detrimental to its strength, even 1-40 of an inch of rust on a 3-4 inch bar will diminish its strength by 13 per cent. Another disadvantage is its excessive expansion and loss of strength under a high temperature. Steel gains in strength with heat up to 500 degrees F, beyond this it rapidly diminishes in strength. With a rise of temperature from the normal to 500 degrees, a beam 26 feet long will expand one inch. With a rise of 1,000 degrees, it will expand one inch to 13 feet. In ordinary house fires, the temperature seldom exceeds 1,000 degrees, but in large buildings it is known to have exceeded 2,500 degrees. This first attracted particular notice during the inspection of the ruins of the great fire at Baltimore in 1904. It was there noticed that in some of the large buildings brass and cast-iron was entirely fused. Fusion had also taken place on the corners and angles of certain steel work. Here it was also noticed that concrete formed a far better fire protection than terra cotta which has many times been further exemplified since that date. This is owing to the expansion of terra cotta being approximately twice that of steel. Under the above conditions, excessive stress is set up in beams, stanchions and frame structures due to the resistance of their loads and fixed ends preventing longitudinal expansion. This stress far exceeds what the steel is capable of resisting, especially in its weakened condition, the beam or stanchion therefore buckles and causes collapse of the structure. Collapse is often due to the deflection of beams causing eccentric loads of the columns which set up a stress far in excess of what they are capable of resisting. Another disadvantage of steel structures is the comparatively high cost of maintenance, also, the fragile appearance of framed structures suggests weakness rather than strength; these framed structures are also unsightly and cannot be made artistic or pleasing in effect without largely increasing their weight, initial and maintenance costs.

Strength, Toughness, Rigidty

In reinforced concrete properly designed and made, the two materials act together as one. An important point in designing is to see that the materials and methods are such as to insure this being the case. Consequently, we have the strength, toughness and rigidity of steel, the appearance of stability and strength, the steel permanently protected from oxidation, no loss of strength with age, a saving in the cost of construction, speedy erection, very little or no charge for maintenance, and a material adaptable to all forms of architectural and structural work. Furthermore, numerous experiments together with the lapse of time and very severe tests to which it has been subjected in existing structures have proved conclusively its absolute reliability for the construction of structures above ground, below ground and under water, for the workmen's cottages to millionaires' mansions, for business premises, hotels, churches, theatres, public buildings, electric power stations, gas works, factory chimneys, reservoirs, water mains, conduits, sewers, grain elevators, roads, bridges, breakwaters and sea defence works and numerous other purposes. It is a method of construction which is fast superseding that of brick, wood, stone and iron, and is far superior to any one of these in resisting water, fire, earthquakes, atmospheric influence, and even burglar attacks which is a great consideration with the construction of strong rooms for banks and business premises. For even with the oxy-acetylene blow-pipe, the time required to cut an opening through a slab sufficiently large to operate would alone prohibit this method of attack without considering the alarming noise of the lamp during operations.

Of the valuable properties reinforced concrete may possess, few will exist if the work is not properly designed and executed. The latter is quite as important as the former, for if the greatest of care is taken with the design and careless supervision given to the construction the result may be as bad or probably much worse than if the work was badly designed. In fact, a poor design well constructed may give a much better result than a good design badly constructed. The supervision should include careful inspection and testing of all the materials; attention to the preparation; erection and removal of the forms; to the gauge mixing and placing of the concrete; to the size and placing of the reinforcement according to the drawings; to the position and condition in which slabs and beams are left unfinished at the end of a day's work;

*Before the Winnipeg Branch C.S.C.E.

to the condition of unfinished work before its continuation or completion; and to the protection of newly finished work from building operations and inclement weather. All these points are of the utmost importance if we aim at the best possible results. It is, therefore, absolutely necessary that constant expert supervision be given to the construction.

Combine Economy With Strength

In designing, strength is generally considered the chief point. Strength, however, should always be considered together with economy. This has not been done in the past to the extent it should have been and the neglect has been very detrimental to the progress of the work. It has given the public the impression that this method of construction is more expensive than brick, stone or steel, but it is not, there is a great saving in cost on large structures and also on small ones, providing there is sufficient of detail to keep down the cost of form construction. Economy in design has sometimes to be considered from two points of view—the engineering and the architectural—these will not always coincide. The most economical engineering structure would have a certain arrangement of beams, slabs, columns, walls, etc., all spaced and proportioned in the most efficient manner and with a definite percentage of reinforcement all determined with due regard to the loading and with a view to obtaining the strongest, most satisfactory and cheapest structure. But if these engineering points were the only ones considered by the architect, the result in some cases would be very uneconomical. The engineering structure may be considered either a plain mass or a skeleton framework devoid of architectural embellishments. The architectural structure is the engineering structure made more presentable by the addition of fittings and embellishments. Economy on the engineering side is purely structural and in a building it is attained or partly attained by keeping the floor slabs thin, by a free use of beams or columns and keeping the beams thin and deep, also by graduating the columns in size according to their different loads.

Architectural Features

This from an architect's point of view might turn out very uneconomical as it might involve so much additional finishing in the way of cornices and other details, also extra expense to secure efficient light and ventilation than would be the case if thicker slabs with fewer and more shallow beams were used. Therefore, if we wish to design economical structures, there are many factors to consider,—the most important of these, however, are the ones which influence all structures and should be considered by both the architect and the engineer where these are both concerned. They are: (1) The ratio of breadth to depth of beams. (2) The percentage of reinforcement. (3) The general arrangement of layout of beams and columns. In regard to the first factor, the most economical section for rectangular beams is when the breadth is about 1-3 the depth but this gives a deeper beam than is desirable for most purposes. To have less depth means an increase of width which is placing the concrete in a less effective position. Consequently, a larger section would be required. The increase in volume and cost, however, is not great until the width exceeds 0.6 of the depth which is a good proportion for general purposes and is the one largely adopted. The depth of a beam with double reinforcement is less than would be required for a beam with single reinforcement. The second set of reinforcement is added to assist the concrete in taking the compression owing to the depth being insufficient to provide enough concrete for the purpose, but compression reinforcement is always very lightly stressed, seldom to more than 7,500 lb. per sq. inch, which is due to the fact that it cannot be stressed more than m. times, the stress in the concrete surrounding it where m. equals the ratio the moduli of elasticity of the concrete and steel. Consequently, a comparatively large proportion of steel is required to make good for a small decrease in the beams depth. Beams with double reinforcement are very rarely as economical as beams with single reinforcement. Their cost will vary with the ratio of breadth to depth, the percentage of steel and the ratio of top reinforcement to bottom reinforcement.

Percentage of Reinforcement

In regard to the second factor, i.e., the percentage of reinforcement. Attention to this is of the utmost importance, great waste is often occasioned through an excess of steel being used. There is certain percentage that will give the most economic section, it is that which is such as to allow both the steel and concrete to be stressed to their allowable limits at the same time. For instance: if the allowable stress for the steel is 16,000 lb. and for the concrete 600 lb., which are the usual values, the concrete and steel should be so proportioned as to allow these stresses to exist when the structure is fully loaded, we then get the full value out of each material. If one of these materials is understressed, it means there is an excess of that material and consequently a waste. Now for different classes of concretes there will be different percentages of steel required to give this result. The difference will depend on the difference in the strength and on the ratio of the moduli of elasticity of the concrete and steel. For hard stone, granite or gravel concrete the modular ratio equals 15 and the economic percentage of steel for the above stresses equals 0.675. For broken brick or limestone concrete the modular ratio is 18. For cinder concrete it is 30. Now from this it follows that in a beam, floor, retaining wall, or any part of a structure under a bending stress and built of hard stone concrete, the sectional area of the steel for single reinforcement should be 0.675 per cent. of the sectional area of the concrete. If there is more than this it will not be fully stressed, therefore, the excess is waste. If there is less than 0.675 per cent. the concrete cannot be fully stressed unless the steel is overstressed. The reason for this is as follows: In any member of a structure under a bending stress the total tension equals the total compression and the tension at any distance from the neutral axis is equal to the compression at the same distance the other side of the axis, also the stress in the steel at any point is equal to the stress in the concrete at the same point or at the same distance from the axis multiplied by the ratio of the moduli of elasticity. Therefore, if this ratio is 15, the stress in the steel is 15 times as much as the stress in the concrete immediately surrounding it, and it cannot be stressed more under any consideration, unless the stress in the concrete is increased.

Position of Axis

This also, is why the compressive reinforcement in doubly reinforced beams is always so much understressed. Now if the axis is at the half depth, the stress in the steel will be 15 times the maximum stress in the concrete, which is little more than half its allowable limit. Therefore, as the steel takes all the tension, much more steel is required than if it could be higher stressed, but to be so it must be further from the axis. The exact distance will depend upon the ratio of elasticity and the allowable unit stresses. The higher the steel is stressed, the less will there be required to take the whole of the stress with the same quantity of concrete, and the further will the steel be from the axis. From this it is evident that when the steel and concrete are fully stressed the neutral axis must be somewhere above the half depth and it approaches the compression surface as the stress in the steel increases. Therefore, the position of the axis varies according to the value of the ratio of elasticity and the proportion of steel to concrete, and as the area of steel and concrete depends upon the intensity of stress, we may say that the axis varies according to the value of the modular ratio and the proportion of area of steel to area of concrete. Also, the maximum stress in the concrete is to the stress in the steel as the distance of the axis from the compression surface is to distance of the axis from the steel. Thus, referring to Fig. 1. c:t :: n: (d-n) m. Where c = the compression at top of beam, and t = tension in the steel; m = the

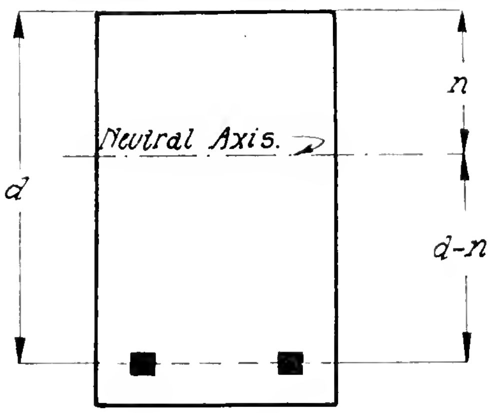


Fig. 1

ratio of the modulii of elasticity of the concrete and steel.

From this we see the error of the early designers in assuming the axis to be at half the depth, we also see that with a certain stress in the concrete for the steel to be stressed to a given amount, it must be at a definite distance from the axis and of a certain sectional area, also that a definite area of steel is required to enable definite stresses to be developed in the concrete and steel. Knowing these fundamentals, there is not much difficulty in designing a beam, the chief factor concerned being the axis and knowing what governs the position of this, it is, therefore, easy to determine. We also know how the stresses vary and that all the compression is taken by the concrete above the axis. With this knowledge, it is only a simple mathematical problem to design a formula whereby we can determine the section of a beam that will contain sufficient concrete above the axis to take the compression, after which we have only to add the percentage of the reinforcement necessary to develop our required stresses.

Materials An Important Consideration

The nature of the materials is a very important consideration. Where strength is the chief point, the concrete aggregate should be gravel, broken granite, trap or similar hard igneous rock. For work up to 3 inches thick, the aggregate should be graded from 3-16 inch to 3-8 inch, and up to 3-4 inch for work 6 inches thick. Above this thickness it may be graded up to 1 inch but not larger. The sand should be quartz, clean and quite free from ligneous organic or earthly matter, and from alkaline or acid pollution. Sufficient should be used to completely fill all the voids in the aggregate with a little in excess.

The cement should be Portland, ground exceedingly fine and in all other respects comply with the standard specification and methods of testing.

The reinforcement should be mild steel. High carbon steel should not be used as its yield point is not so reliable as that of mild steel. It should have an ultimate strength of not less than 60,000 lb. per sq. inch with a yield point not lower than 50 per cent. of the ultimate strength: it should be free from seams and foundry scale and under no consideration should it be painted or galvanized as this prevents the adhesion of the concrete to the steel and thus destroys the bond upon which the theory of design depends.

New Deep Water Terminals, Halifax

(Concluded from page 30)

closely as possible to the natural shore line, so that excavating below water for the required depths would be at a minimum. However, it is necessary to dredge about 250,000 cubic yards of the rock bottom to attain the desired low-water depths (maximum 45 feet), and this spoil is used mainly in filling in behind the walls. This excavation for the most part is in fairly hard rock which requires blasting before dredging; but in some low areas the rock lies at a depth of from 50 to 90 feet and it is necessary to dredge out the overlying mud. In these sections a granite rubble mound is deposited to form a foundation for the quay-wall blocks.

The deep-water terminals at Halifax are being built by the Department of Railways and Canals, under the direction of the Minister, Hon. Frank Cochrane, and under the direct personal supervision of F. P. Gutelius, General Manager of the Canadian Government Railways. Design and construction are in immediate charge of James McGregor as Superintending Engineer, with F. W. Cowie, of Montreal, as Consulting Engineer on the dock works, and C. B. Brown, Chief Engineer of the Canadian Government Railways, as Consulting Engineer on the railway works. A. C. Brown is Resident Engineer on the dock works, R. H. Smith is Resident Engineer on the railway works, and J. J. Macdonald is Office Engineer. The railway grading contract is held by the Cook Construction Company, Limited, and Wheaton Bros., with Andrew Wheaton and I. J. Bowes in charge, and the dock contract by Foley Bros., Welch, Stewart & Fauquier, with J. P. Porter and R. B. Porter in charge of operations representing the company, and J. W. Roland as their Chief Engineer.

The Canadian National Clay Products Association will meet in convention at the King Edward Hotel, Toronto, on January 18, 19 and 20.

The annual meeting of the Canadian Society of Civil Engineers will be held in Montreal, January 25, 26 and 27. President, Mr. Geo. H. Dougal. Secretary, Professor McLeod.

Honors for Canadian Engineers

A keen appreciation is shown of some of our best Canadian types in the engineering and contracting field in conferring new year's honors on such men as Collingwood Schreiber, William Duff Reid, John Kennedy and Sir Thomas Shaughnessy.

Sir John Kennedy, consulting engineer of the Montreal Harbor Board, comes of a family which for many generations has been connected with engineering in one form or another. He is a son of the late Mr. William Kennedy, founder of the firm of William Kennedy and Sons, Limited, Owen Sound. He was born in Spencerville, Ont., in 1838, and educated at Ottawa, and later in McGill University. As early as 1875 he was appointed to the position of chief engineer of the Montreal Harbor Commission, and has had charge of several large works such as rebuilding the Montreal harbor wharves, the deepening of the ship canal between Montreal and Quebec, the entire remodelling of the Montreal harbor and important Government works for the improvement of the deep water terminus of the Intercolonial Railway at Halifax, recently completed. He has also been connected, either as constructing or consulting engineer, with a number of Canadian power projects, including Niagara Falls, Chaudiere Falls, the power plant at Kenora, the Beauharnois plant and a number of others. Sir John was one of the founders of the Canadian Society of Civil Engineers, is past president and an honorary member. He has also served on the board of directors of the American Society of Civil Engineers and on the council of the Institution of Civil Engineers. Since 1907 he has withdrawn more or less from active constructional work, but has been retained by the Harbor Commissioners in a consultant capacity, which position he still holds.

Baron Shaughnessy.

Sir William Duff Reid is a son of Sir Robert Gillespie Reid, and since his father's death, in 1908, has presided over the destinies of the Reid-Newfoundland Company. He was born in Australia in 1867, but came to Canada in 1871 and settled near Galt, where his early education was obtained. His first piece of construction work was about eight miles on the Algoma branch of the Canadian Pacific Railway. Later he had charge of the construction of a branch of the Intercolonial in Cape Breton. Since 1890 he has confined his attention to the business which bears his name, one of the most considerable in extent on this continent. The operations of the Reid-Newfoundland Company on the island of Newfoundland comprise a railway some 600 miles long, an extensive telegraph system, a fleet of steamships and large power developments and manufacturing interests, all operated under the name of the Reid-Newfoundland Company of which Sir John is president and general manager.

Sir Collingwood Schreiber, as far back as 1863, was divisional engineer of the Nova Scotia Government on the Pictou Railway. In 1867 he became associated with the Intercolonial Railway, and in 1873 was appointed chief engineer and general manager of these roads. In 1880 he succeeded Sir Sandford Fleming as chief engineer of the Canadian Pacific Railway Company, and in 1892 was appointed chief engineer of the Department of Railways and Canals, with the additional office of Deputy-Minister of Railways and Canals. In 1905 he was appointed chief general consulting engineer of the Dominion Government and chief engineer of the western division of the National Transcontinental Railway.

Sir John Kennedy.

Sir Thomas Shaughnessy, who now becomes a Baron, has been connected with the Canadian Pacific Railway since 1881, when he was appointed purchasing agent of the company. Ten years later he was appointed vice-president. In another eight years, that is, in 1899, he succeeded Sir William Van Horne as president. The history of Baron Shaughnessy is largely the history of the Canadian Pacific Railway, generally recognized as the best managed steam road on the continent of America. He was born in Milwaukee in 1853. Of all the New Year's honors none resulted from higher merit—none will be received with greater approved by the citizens of the Dominion of Canada.

Some Good Contracts

Cloisonne and Art Glass, Limited, manufacturers of art glass, electrical goods, and ornamental iron work, Berlin, have recently received some contracts, including the following:—

Drumbo—leaded glass, wiring, and electrical fixtures for the new Presbyterian Church.

Preston—wiring and electrical fixtures in the Lutheran Church.

Petersburg—leaded glass in the new Lutheran Church.

Berlin—leaded glass windows in the addition to the Zion Evangelical Church, and glass and sky-light prism for the new Economical Building.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

Sir Robert Borden's New Year's message to the Empire carries with it the hearty endorsement of every Canadian worthy of the name. There may be differences of opinion as to whether the Dominion can raise half a million troops without resorting to conscription, but all are of one mind as regards her intention to try. Everybody is agreed that the war is as much our war as it is the Mother Country's; that our freedom is involved just as hers is. After more than a year of fighting Canadians realize how big is the task that has been undertaken. They also realize that the magnitude of that task proves more than ever how great was our danger. Sir Robert Borden has voiced our unalterable determination to pursue the war to a victorious finish whether it takes half a million or a whole million of our sons and the last dollar that we as Canadians can raise or borrow.

* * *

According to the Canadian Patriotic Fund, several firms engaged in the manufacture of munitions have decided to devote a percentage of their profits to the fund for soldiers' families. And while it may be wrong to look a gift horse in the mouth, it is always well to have an eye out lest the animal have a kick in his left hind leg. This unlooked-for liberality comes on the top of, and perhaps in answer to, a suggestion that war profits be taxed. If this suggestion is acted upon the Government and not the contractor will have the dividing of the profits and the fixing of the share the contractor is to retain. While I believe that individual contractors might act with even unseemly generosity the fact remains that most of the contractors are corporations. And it has yet to be proved that corporations have souls. Then, again, you know certain stocks have been sold because of the dividends the profits assured. Might not an occasional contractor argue that his first duty was to the widows and orphans who had invested in his stock? Taking it by and all, the matter can be viewed from too many different standpoints, and as the result must do the greatest good to the greatest number an independent tribunal must work out that result. That tribunal must also be in possession of all the facts concerning all contracts. So we arrive as usual at the absolute necessity for an investigation of the Shell Committee.

* * *

The report of Sir Alexander Bertram's resignation appears to have been grossly exaggerated. Still there are those who believe that the noble knight will never find his health sufficiently restored to permit of his return to his arduous duties. He has issued two valedictories and received one title. He has explained his position to Sir Sam Hughes and the Toronto Globe. He has not laid down the burdens and cares of office, but he has gone out from among us carrying them with him. It is to be hoped, however, that he will be sufficiently recovered to attend the investigation into the affairs of the Shell Committee which the present session of Parliament can hardly fail to provide.

* * *

Of the $13,000,000 advanced by the Government to western grain growers last spring it is claimed not $1,000,000 has been repaid, and according to the Winnipeg Telegram the farmers are evading payment in the hope that the debt will eventually be cancelled. This, coming on top of the greatest crop in the history of the West, is not encouraging. When the farmer was in need the Government went to his aid; now the Government is in need—of every dollar it can raise or borrow for the purpose of carrying on the war—and the farmer refuses to do his duty. Truly the farmer does not appear in a patriotic or grateful light. Of course the government is secured, but out of a ripe experience the farmer probably figures that a close election might induce a certain leniency. Then again there are stories that shell manufacturers are making enough out of their shell contracts to be able to scrap their plants when the war is over. Does the farmer argue that a Government that buys plants for contractors should also buy seed for farmers? Maybe so. Still, a cry for "free wheat" comes with very poor grace from men who in the hour of need got financial aid from the Government and now in time of their plenty try to evade payment of the money received. And yet if a Government will play practical politics with its people it is not surprising if said people occasionally give the Government a dose of its own medicine.

* * *

Brigadier-General—pardon me, Sir Alexander—Bertram is off to summer lands in search, we are told, of new health, and hurtling through the air in his direction goes a title. And surely no man ever tried so hard to earn the Government gratitude the title implies. Sir Alexander has loaded all the cares, crimes and virtues of the Shell Committee on his shoulders and tried to take them south with him. And the Government cares not where they go so long as they are out of sight and have any kind of a chance of being out of mind. But the public refuses to forget some things—and the Shell Committee is one of them. The public wants to know all about it, and is clamoring for an investigation so insistently and audibly that the Conservative press are hearing it even above the calls of party loyalty. That old-time Conservative organ the Hamilton Spectator is one of the latest to climb the fence and voice the sentiments of its subscribers. The Spectator hasn't made any half-way jump like the Ottawa Journal. It places the responsibility where it belongs—on the shoulders of the government. In an editorial dealing with the Shell Committee the Spectator says:

"Upon the Dominion Government rests the duty of setting on foot a most thorough and rigid investigation of its operations from beginning to end, and we cannot doubt that the ordaining of such an investigation will be regarded as one of the first tasks of Parliament at its approaching session."

How many more prominent Conservative journals will have to speak before Sir Robert Borden realizes that the machine oilers by whom he is surrounded do not voice the sentiments of the people?

* * *

When somebody blundered at Ottawa and the patriotic public was led to believe that our boys needed machine guns, the Montreal Star was one of the first to appeal for funds for the good cause. You'll remember the money came with a rush. Then one sad day it was announced that the machine guns were not needed, or could not be bought —or something. Since that time the Star has been busy refunding money to all applying subscribers. At the close of the year it was obliged to confess that there was still $8,000 in the bank, all ready for some one to prove property and take the animal away. By the way what has happened to the money the Government received for this purpose?

* * *

Is Canada to receive no more shell contracts? This idea prevails in certain quarters. Still it was only the other day that Lloyd George was appealing to the patriotism of Glasgow workmen. And that appeal surely carried a conviction that the Empire needs all the munitions her factories can make. Does it all mean that so far as munitions and munition contractors go Canada is not looked on as part of the Empire but rather as a neutral country? Are our contractors put in the "cold business" class occupied largely by our Yankee cousins? Has Britain refused to forget that when men cried from the trenches for shells the Canadian manufacturer came forward with a dollar's worth of shell in one hand while the other hand was held out for $5.00? Are we to give our sons to the Empire by the half-million and yet to have a cold, hard, commercial rating that belies our loyalty? Is Canada as a whole to suffer that a few may become rich? These are questions we are not to ask. The answers might harm some of our alleged leaders. And we must be loyal to our leaders rather than to the Empire and the freedom the continuance of that Empire assures us.

* * *

We are informed from Ottawa that the work of the Davidson investigating commission is almost finished. To criticize that work would probably be considered contempt of court and I would hate to be the only one to receive punishment at its hands. But I fain would ask a question or two. Surely one may venture that far. And my first query would naturally be: "In the Hopkins investigation was it Mr. Hopkins or Mr. Acton who was being investigated?" And following this would it be unwise or unkindly to ask why Mr. Hopkins was not called to the stand? Mr. Hopkins' home is in Toronto, but he is taking most of his meals at the Biltmore Hotel in New York City. I believe he prefers the New York climate and if he does spend an occasional Sunday in Toronto it is because his family still resides in the Queen City. Of course he might have gone to Ottawa as a witness but those attorneys have a way of talking to mere witnesses that does not make their position in the box an attractive one. Still I believe that Mr. Hopkins could have been persuaded to take the stand. And a lot of people would have read his testimony whether it was interesting or not.

* * *

Henry Ford has returned to the continent and country of which he so proudly forms so large a part. He has learned that while a little thing may start a war it is a man's job to stop it. It has perhaps dawned upon him that he is not that kind of a man.

* * *

And now it is claimed that the Allies are placing orders in the dominions for forty million dollars worth of lumber. Tremendous quantities of it are being destroyed on all fronts every day. Norway and Sweden are being swept clean and the Allies now have to go further afield for their supplies. Add to this the amount necessary to rebuild the various war zones and you'll be prepared to admit that the man who has a timber limit is almost as well off as he who rejoices in a shell contract.

* * *

Sir Sam Hughes, General Logie and others are confident that half a million men can be recruited in Canada. But when you stop to consider that statisticians figure that only ten per cent. of a country's population are available for service you have a doubt. Placing Canada's population at eight millions you would have 800,000 as her total available population for military purposes. It would be optimistic to say the least to expect five out of every eight of those to come out voluntarily and enlist. Still Sir Sam says it can be done. And if you're from Ottawa you know that what Sir Sam says goes.

There have been several additions to the select circle of Canada's aristocracy during the last week or two. I haven't the slightest objection to offer but what with honorary colonels, honorary generals, knights, barons, etc., the upper tiers of this young country are becoming a bit crowded. That chap who said there was plenty of room at the top evidently lived before the present war got in its deadly work.

* * *

Toronto Saturday Night has rushed to the defence of the Shell Committee even while Conservative organs are tumbling over each other to show their independence by demanding an investigation. As a defender of the defenceless the Toronto society paper is in a class by itself. It has long been noted for its tenderness of heart and its disinterested kindness to any and all whose sufferings were called to its notice. The present instance is no case of contracted kindness.

* * *

By the way, where is that amiable young Canadian patriot Hon. W. L. MacKenzie King these trying war times? Is he helping John D. Rockefeller to spend his millions, or is he telling his countrymen to go to war and fight for the county he is so fond of representing? Not so very long ago Mr. King was issuing warnings to the proletariat of Waterloo County that are strangely at variance with the speeches he delivers at patriotic meetings. You'll remember how on one historic occasion he solemnly declared:

"Are the people of this country going to place at the head of affairs a man who takes such a position as Borden was in over a year ago, when he was prepared to take from the treasury of the country, and would have taken it had he been at the head of the Government, enough money to build two Dreadnoughts, to send that money to England, telling them to sink it in warships? The amount of money he was prepared to send there to take out of the treasury to build warships to fight Germany is more than is being spent for the whole service which the Liberal Government is constructing, and which, when built, will remain around our own shores as a protection, and not as jingoes might want to use it."

* * *

"Three million dollars is the value of Manitoba Agricultural College buildings as they stand, including the site and furnishings, according to an official report made to the Government by the Canadian Appraisal Company of Montreal, appointed some time ago to make a valuation of the Provincial buildings. The Agricultural College cost the Province approximately four million, it was stated in Government circles. Where did the other million dollars go?"

Let me see, was not the Hon. Bob Rogers then Minister of Public Works?

SEARCHLIGHT.

Personal

Mr. C. E. Tisdall is the new Minister of Public Works of the province of British Columbia.

Mr. Arthur Reid, Commissioner of Public Utilities for the city of Lethbridge, Alta., has resigned. He is succeeded by Mr. Freeman.

R. J. McClelland, city engineer of Kingston, who applied for and was granted a commission as captain in the 146th overseas battalion, will be unable to go to the front on account of being pronounced physically unfit.

Sergeant A. Grant MacDonald, of the 125th Battalion, formerly Assistant Superintendent of Construction with The Schultz Brothers Company, Limited, of Brantford, Ont., has been transferred to the Canadian Aviation Corps with the rank of Flight Lieutenant. Lieut. MacDonald's departure was made the occasion of the presentation by his firm of a handsome portmanteau.

Mr. P. A. McDonald, Winnipeg, has been appointed Public Utilities Commissioner for Manitoba, succeeding H. A. Robson, who resigned some weeks ago.

Mr. G. W. Caye has been appointed purchasing agent of the Grand Trunk Railway System, with headquarters at Montreal, succeeding J. G. Guess, resigned.

Mr. G. S. Michel, formerly assistant director of Public Works of the Province of Quebec, has been appointed engineer and director of public works, succeeding E. Charest, retired.

Mr. F. B. McFarren, until recently general manager of the Interprovincial Brick Company of Canada, Limited, has received an appointment as Lieutenant with the 83rd Battalion, C. E. F. Mr. E. G. Glen has been appointed acting manager during his absence.

Obituary

Mr. D. Sauve, of Hull, Que., for the last eighteen years employed by the Hull corporation as foreman of works, died last week. Mr. Sauve was well known in Hull, where he had lived the greater part of his life.

Mr. George I. Ainsworth, of Orillia, Ont., died at Guelph recently while on a business trip. He represented the R. A. Lister Company, manufacturers of gasoline engines, Toronto. He travelled over a wide area for them, and was looked upon as an expert in his line.

Mr. W. H. Mitchell, a well-known citizen of Calgary, died recently after a six-weeks' illness. He was a civil engineer, and was engaged in the contracting business for many years. Recently he had been engaged in work for the C. P. R. He was born at Truro, N. S., and lived in Kingston, Ont., for many years, moving to Calgary about nine years ago. A widow and three sons survive him. A fourth son, Robert, fell in the battle of St. Julien last April.

Mainly Constructional

East and West—From Coast to Coast

The Panama Canal has cost the United States $357,436,048. Of this amount $14,689,873 has been devoted to fortifications.

Jas. Worswick Company, Limited, contractors, of Winnipeg, Man., have changed the style of the firm to that of Jas. Worswick, Limited.

There was a decrease of $10,542,399 in the value of building permits issued by the city architect of Toronto during 1915 as compared with 1914.

On December 30th the engineering departments of the city of Saskatoon held their annual banquet at the King George Hotel. Representatives of all the mechanical departments of the city were present, and an enjoyable evening was spent.

The Montreal Council will spend $12,940 on the construction of a purifying pit at the mouth of the Notre Dame de Grace sewer. Controller Cote states that the city must soon be prepared to purify all its sewage before emptying it into the rivers.

Building permits issued by the city of Quebec during 1915 totalled 1444, and amounted in value to $2,578,042. The number of permits issued last year was more than double that of 1914, but the value of the preceding year was greater, the total cost of the new buildings erected in 1914 having been $2,759,573.00.

Judge E. H. Gary, Chairman of the Board of Directors of the United States Steel Corporation, says that the present rate of production of steel ingots in the United States is about 41,000,000 tons per annum. The previous best record was 35,000,000 tons in 1913.

Mr. Ernest Drinkwater has been reappointed engineer for the corporation of St. Lambert, P. Q. Mr. Drinkwater was originally engaged for three years as town engineer, and as the term expired recently, it was necessary for the Council to make a further appointment.

The Western Machinery Company, Limited, has been formed at Port Arthur, Ont., with a capital of forty thousand dollars, to manufacture machinery, boilers, iron and steel, etc. The provisional directors are R. B. Roberts, P. D. Munroe, A. McPherson, W. F. Langworthy, and L. McComber.

Building figures of Windsor, Ont., for December show an increase in value of $82,730, compared with the corresponding month in 1914, the total being $127,600. Figures for the whole of 1915 show building operations decreased to the extent of $475,548, as compared with 1914, when the total value was $1,121,413.

A statement of building permits for the town of Welland, just issued by Mr. D. T. Black, town engineer, shows a total for the year of $191,232 as against $337,918 in 1914. The month of December, 1915, with $19,635, showed a marked increase over the same month in 1914, when permits amounted to only $2,250.

The Chatham, Ont., branch of the Builders' Exchange met recently to do honor to two of their members, Mr. Arthur Back and Mr. W. Boa, who have enlisted with a Hamilton regiment. There was a large attendance, and a splendid banquet was served, after which Messrs. Back and Boa were presented with wrist watches.

The report of the building inspector, Mr. S. M. Jarrett, of Vancouver, B. C., for December, 1915, shows that the total value of permits granted for the month was $27,180 as compared with $39,765 in the same period in 1914. The value of building permits for the twelve months of 1915 was $1,593,279 as against $4,484,476 for the previous year.

The Consolidated Steel Company, Limited, Toronto, have obtained a charter. Their capital is one hundred thousand dollars, and they will carry on the business of iron founders, mechanical engineers, manufacturers of machinery, builders, electrical engineers, etc. The provisional directors include William H. Beatty, F. A. Hammond, and C. B. McClurg—all of Toronto.

The contractors who aided in the work of building the new Hotel Vancouver, Vancouver, B. C., were entertained on December 28 at a banquet given by Messrs. Skene & Christie. The menu was a unique creation. It was "done" in blue print and contained "specifications" of the banquet, listing the eatables as "primings," "foundations," "sub-basement," "basements," "ground floor," "Mezzanine," "typical," "roof garden," etc.

A report of building statistics for the city of Montreal for the past year just issued by Mr. Alcide Chausse, architect and superintendent of buildings for the city, indicates that the total value of 2,081 permits for 1915 was $8,511,221 as against a value of $17,394,244 for 3,629 permits in 1914. For the month of December alone, 1915, 104 permits represented a value of $2,044,425 as against $361,135 for 144 permits in 1914, indicating increased activity in the larger type of building construction work.

Application will be made to the Quebec Legislature by the Vercheres, Chambly and Laprairie Tramways Company to construct an electric railway on the south shore of the St. Lawrence, with the right to enter Montreal. It is proposed to conduct operations between Saint Roch and Chateauguay, and from Laprairie to Chambly, with loop lines and connection branches to other places in the counties of Chateauguay, Laprairie, Chambly, Vercheres and Richelieu, and across the St. Lawrence River to Montreal.

Seattle, Wash., is to have what its builders declare will be the largest and finest salt-water natatorium in America. Plans have been completed and contracts let, and May 15 set as the definite day of opening. The building, of steel and glass, and architecturally one of the most distinctive in the West, will occupy a site fronting 180 feet on Second Avenue and 108 feet on Lenora Street. The natatorium will represent an investment of $200,000, exclusive of the site, which is under a long-time lease from Mr. Charles D. Stimson.

A large delegation composed of representatives of all the parishes between Levis and Rimouski, recently waited on the Hon. J. A. Tessier, Minister of Roads for the province of Quebec, asking that a modern highway be constructed from Levis to Fraserville and Rimouski. It was pointed out by the various speakers that the construction of such a highway would not be difficult, as there was already a good roadbed over the greater part of the way. The advantages of such a highway, following the course of the river, for tourist travel and for the development of agriculture would be immense. The Minister promised to confer with his colleagues on the matter.

The official statement of the Montreal city public works department, under Mr. Paul E. Mercier, chief engineer, shows a considerable reduction in the proposed expenditure for the current year. The total is $1,646,137, including $413,475 yet to be voted for the roads department, outside, against $1,867,505 last year and $2,715,072 in 1914. Considerable economies are estimated in practically all the departments, the engineers' office being put down at $24,150 instead of $30,150. There is a cut of $21,150 in the estimated cost of repairing roads, the total being $196,170; the city has now 196.17 miles of paved roads, an increase of 40 miles, but in spite of this, less money will be available for repairs.

The Court of Appeals of the Dominion of Canada have awarded Messrs. J. A. McIlwee & Sons, the firm of Denver engineers who drove the five-mile railroad tunnel through the Selkirk Mountains, a verdict of $800,000 against the Canadian Pacific Railroad Company. For certain reasons the company cancelled the contract. The engineers sued in the British Columbia Supreme Court for breach of contract and for the bonuses then due. They were awarded $527,000. The Canadian Pacific then appealed the decision, but the Court of Appeals not only upheld the award in favor of McIlwee & Sons, but increased it to $800,000. The Canadian Pacific have now appealed that award to the British Privy Council.

Mr. John Hartnett, of Toronto, has completed the work of installing the water-works system in Hespeler, Ont. The reservoir has a capacity of two hundred thousand gallons. It is fed from two artesian wells, with apparently an abundant supply of water. The capacity of the standpipe is one hundred thousand gallons, and it gives a working capacity of from twenty to one hundred pounds pressure. The town system has just been connected with the R. Forbes Company's system. In case of a big fire the Forbes Company's pumps would be able to give three thousand gallons a minute into the town's mains. The town pumps could give eight hundred gallons a minute, making this a duplicate system if so required.

Every effort to unravel the mystery surrounding the disappearance from the city of Calgary's vaults of the documents in connection with the proposed new three million dollar Elbow River water-works scheme has been unavailing. The maps, records, etc., represent $10,000 worth of work, and would cost approximately that sum to replace should the city ever decide to go on with the work, and their loss is a serious embarrassment to the city. The missing records vanished from the big safe in the engineer's office some time in May last. The fact was kept a close secret for months in the hope that some clue would be found that would lead to the recovery of the documents and the apprehension of the thief.

Mr. H. P. Borden, assistant to the chief engineer for the Quebec Bridge, says that if the programme of work as outlined is carried out it will be possible to run trains across the bridge at the close of next season. By October the great suspended span, which is 640 feet long, and weighs 6,000 tons, will be floated to its place. This great undertaking was begun nearly eight years ago by a private firm. Subsequently the bonds of the company were guaranteed by the then Government. During its first construction the bridge gave way, and some 95 people lost their lives. The Quebec Bridge was one of the legacies inherited by the present Government. When finished it will have cost some seventeen million dollars. It was at first calculated that the bridge could be built for six million.

France, with all her troubles of the last year and a half, has been able to develop one new industry not connected with war munitions. The French are now said to be turning out excellent cement from a by-product in the process of making beet sugar. From 70,000 tons of beets treated, more than 3,000 tons of cement, equal in quality to the best Portland, is obtainable, purely as a by-product. The scum which forms when the beets are boiled, and which hitherto has been thrown away, is pumped into large tanks, where it is allowed to dry partially. Finely divided clay is mixed with it, and the mixture is thoroughly amalgamated by beaters for an hour and then burned in a rotary kiln, just about as Portland cement is treated. The clinker is removed and pulverized into cement. The best scum, formerly a waste product, was found to contain large quantities of carbonate of lime and water. Four thousand tons of this carbonate is obtained from 70,000 tons of beets. To this is added 1,100 tons of clay, the resulting product being 3,162 tons of excellent cement.

Quantity Surveying

One is just a bit surprised to know that St. Louis is going to give the quantity surveyor idea a trial; it is not a trial, by the way; they have adopted the idea. The civil engineers of that city are responsible for it. Following a campaign by civil engineers, through their organization, the city assembly passed an ordinance authorizing the mayor, with the approval of the council, to appoint quantity surveyors. The number is not limited. The appointees must be skilled in building construction or estimating. They must give bonds in $10,000. Patrons of quantity surveyors, who sustain loss by reason of their negligence, incompetence or misconduct can sue on the bond any time in five years. The charges authorized are the fees agreed upon between surveyor and clients, until a list of fees can be prepared by the Engineers' Club, St. Louis Chapter, A.I.A., and the Building Industries Association. Supplementing the ordinance of St. Louis a state law is being prepared requiring a detailed quantity list with every architectural and engineering plant.—Architect & Engineer.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Amherstburg, Ont.
C. H. Leslie is considering the purchase of a quantity of 4-inch and 5-inch drain tiles for work to be done in the spring.

Cornwall, Ont.
A by-law has been carried authorizing the construction of a waterworks system at a cost of about $25,000. In connection with this, the Town Council will require one steam pump, two boilers, turbine, water pump, and a quantity of 6-inch and 8-inch cast iron pipe. Clerk, J. G. Harkness.

Kingsville, Ont.
The Town Council are considering the construction of a sewage system next summer. Clerk, George Pearse.

Meaford, Ont.
The by-law authorizing the expenditure of $4,000 on extensions to the watermains has been carried. Work will start in the spring. About 2,000 feet of 4-inch pipe and 40 house connections will be required. Town Clerk, G. J. Albery.

Ottawa, Ont.
The by-law providing for the construction of a driveway along the Rideau River has been carried. City Engineer, F. C. Askwith.

Sarnia, Ont.
The by-law to authorize the extension of the watermain system has been carried. Approximate cost, $12,000. City Engineer, John A. Baird.

Whitney Township, Ont.
The Provincial Road Commissioner, J. F. Whitson, Toronto, has decided to remetal the road between South Porcupine and Timmins. Work will start in the spring. Estimated cost, $50,000.

Railroads, and Bridges Wharves

Berlin, Ont.
The Grand Trunk Railway Company, Montreal, have been empowered to construct two railway spurs on part of Lot 16, occupied by the Berlin Light Commissioners and L. B. McBride & Company, Limited.

Erin, Ont.
Permission has been granted to the Canadian Pacific Railway Company, Montreal, for the construction of an extension to an industrial siding for the Rocsand Company, Limited, at mileage 4.10, Elora Sub-division.

London, Ont.
The City Council are considering the erection of a cement bridge over the Thames River at Richmond Street. Approximate cost, $40,000. Engineer, H. A. Brazier.

Ontario Province
The Toronto-London Hydro Electric Railway By-law has been carried in the following places: — Toronto, London, Guelph, Berlin, Stratford, Mimico, New Toronto, Waterloo, St. Marys, Milton, Port Credit, New Hamburg, and the townships of London, Trafalgar, Wilmot, Downie, Nassagaweya, Guelph, North Easthope, Biddulph, Esquesing.

Quebec Province
The Canadian Pacific Railway Company, Montreal, have been authorized to construct sidings for the following:— Frank Davis, mileage 14.5, St. Gabriel Sub-division; City of Outremont; French Government Remount Depot, mileage 156.9, Quebec Sub-division; Dominion Cartridge Company, Limited, mileage 1.9, Staynerville Branch.

Toronto North, Ont.
The Canadian Pacific Railway Company, Montreal, have been empowered to construct an industrial siding for the Corrugated Paper Company, Limited, North Toronto.

Toronto West, Ont.
The Board of Railway Commissioners have authorized the Canadian Pacific Railway Company to build an industrial siding for R. G. Dryden, West Toronto.

Public Buildings, Churches and Schools

Athabasca, Alta.
Tenders on the erection of a frame school will be received until noon, January 14th, by George Watt, Athabasca, Secretary to School District No. 3014. Plans and specifications with Secretary.

Carleton Place, Ont.
The by-law to authorize the erection of a school at the approximate cost of $35,000 was defeated.

Euphemia Township, Ont.
The Township Council contemplate submitting a by-law to authorize the construction of a public hall in the Police Village of Florence. Clerk, D. M. Smith, Cairo, Ont. Estimated cost, $3,000.

Fredericton, N.B.
The Public School Board are having plans prepared for an addition to the Charlotte Street School. Architect, G. E. Fairweather, 84 Germain Street, St. John.

Galt, Ont.
A by-law has been carried to provide for the raising of $50,000 for the erection of a school in the North Side District. City Clerk, Joseph McCartney.

Howick, Que.
The erection of a school is being considered by the School Board. Secretary, D. R. Hay. Estimated cost, $3,000.

Ingersoll, Ont.
The by-law to authorize the erection of a school at an approximate cost of $70,000 has been defeated. Town Clerk, W. R. Smith.

La Prairie, Que.
The School Board contemplate the erection of a school, estimated to cost $3,000. Secretary, A. F. Grondiu.

Ottawa, Ont.
The Redemptorist Fathers, Bayswater Avenue, contemplate the erection of a church on Spadina Avenue. Architect not yet appointed.

Peace River Crossing, Alta.
The Trustees of School District No. 25 have been empowered to borrow $7,500 for the erection and equipment of a school. Treasurer, H. A. George, Peace River Crossing.

St. Alphonse de Thedford, Que.
The erection of a school is being considered by the School Board. Estimated cost, $3,000. Secretary, Achille Therrien.

St. Antoine de Bienville, Que.
Tenders on interior work at the Parish Church will be called about March 1st. Architect, P. Levesque, 115 St. John St., Quebec.

St. Jerome, Que.
The School Board are considering the erection of a school, estimated to cost $3,000. Secretary, Charles A. Lorain.

St. John, N.B.
The project for the erection of a school has been laid over by the Separate School Board until the spring. Tenders will be called and material purchased by the Architect, R. A. Frechet, 200 Main Street, Moncton.

St. Timothee, Que.
The erection of a school at an approximate cost of $3,000 is contemplated by the School Board. Secretary, J. D. S. Tremblay.

Stamford, Ont.
The Trustees of School Section No. 4 are receiving tenders on the installation of a water system at the School. Secretary, A. B. Warren, South End, Ont.

Stamford Township, Ont.
Plans of a school are to be prepared immediately for the Trustees of School Section No. 2. Secretary, James Brown, Thorold. Estimated cost, $7,000.

Stanstead Plain, Que.
Tenders on the erection of a Registry Office, Court House and Municipal Hall will be received until noon, January 15th, by the County Secretary, A. N. Thompson, Stanstead Plain. Plans and specifications at the Registry office.

Walkerville, Ont.
A by-law has been passed authorizing

the expenditure of $21,000 on the construction of pavements on a number of streets. Town Clerk, William Murray.

Weston, Ont.
The Board of School Section No. 31, York, have decided to make improvements to the heating, ventilating and drainage systems at the School. Secretary, C. H. Smilie.

Young's Valley, Alta.
Permission has been granted to the Trustees of School District No. 2166 to borrow $8,000 for the erection and equipment of a school. Treasurer, A. E. Martin, Youngstown. Brick veneer construction.

CONTRACTS AWARDED

Hamilton, Ont.
The following contracts have been let by the City Council for work at the City Hospital:—boiler, Watrous Engine Works Company, Brantford, $1,025; motor, Canadian Westinghouse Company, $1,965; electrical work, Culley & Breay, King Street West, $6,000.

Toronto, Ont.
In connection with Epworth Methodist Church, now being built on Yarmouth Road, the contract for plumbing, heating and wiring has been awarded to Keiths Limited, Campbell Avenue, the plastering to Hoidge & Sons, 34 Price Street, and the painting to F. R. Fowler, 248 Christie Street.

Business Buildings and Industrial Plants

Aylmer, Ont.
George Pellatt, Main Street, is considering the erection of a store. Frame construction. Work will probably be done by day labor.

Goderich, Ont.
R. McAllister, Bayfield Road, R. R. No. 2, Goderich, intends to rebuild his barn. The work will probably be done by D. McLaren, Goderich.

Guelph, Ont.
W. A. Mahony, Telephone Building, will shortly call for tenders on the erection of a stove factory. Site not yet decided on.

Kincardine, Ont.
The Ontario Peoples Salt & Soda Company, Limited, are about to construct an addition to their plant at an approximate cost of $14,000, as the by-law to grant them exemption from taxation has been carried. Manager, John Tolmie.

Lindsay, Ont.
T. Hudgson, 9 Tecumseh Street, Orillia, is about to erect a chemical plant, the by-law to grant him certain concessions having been passed. Approximate cost, $60,000.

Listowel, Ont.
A by-law has been carried authorizing the loan of $12,000 to H. B. Morphy, F. W. Hay, A. H. Hawkins and J. S. Gee for the erection of a boot and shoe factory.

Milton, Ont.
T. D. Hume intends to start work in the early spring on the erection of a store. Estimated cost, $5,000.

E. F. Earl will rebuild his shop in the spring. Brick construction. Approximate cost, $3,000.

Moncton, N.B.
The Militia Department are about to start work on interior alterations to the premises of the Record Foundry Company, 31 Foundry Street. They will also instal 10-inch sewer and 4-inch water services. Work will be supervised by Engineer John Edington.

Niagara-on-the-Lake, Ont.
George Reed has commenced the erection of an addition to the Royal George Theatre. Frame construction, concrete foundation.

Owen Sound, Ont.
The Owen Sound Shoe Manufacturing Company, Limited, are about to remodel the Pacific Hotel, as the by-law to grant them a loan has been carried. Promoter, W. E. Wilson.

Parry Sound, Ont.
A. Logan, James Street, is rebuilding his business block by day labor. Some steel beams and pillars may be required.

Regina, Sask.
H. G. Smith, Limited, Bread and Sixth Streets, propose to erect an addition to their premises in the early spring.

Ridgeway, Ont.
Chester Johnson is building a business block on Ridge Street by day labor. Concrete block construction, steel roofing. Estimated cost, $5,000.

Sandwich, Ont.
A by-law has been carried granting tax exemption to the Cadwell Sand & Gravel Company, 84 Sandwich Street, Windsor. Work will probably start shortly on the construction of a plant for the manufacture of building material, etc. Estimated cost, $40,000. Particulars from C. W. Cadwell.

Saskatoon, Sask.
H. G. Smith, Limited, Bread and Sixth Streets, Regina, are considering the erection of a branch warehouse. Work may start in the spring.

St. John, N.B.
Plans are being prepared for rebuilding the premises of W. H. Thorne & Company, Limited, Market Square. Architect, F. N. Brodie, 42 Princess Street. Estimated cost, $50,000.

Toronto, Ont.
White & Thomas, 139 Simcoe Street, contemplate the erection of a warehouse, estimated to cost $3,000. Tenders are now being received by the Architect, W. Connery, Manning Chambers. Brick construction, felt and gravel roofing.

Whalen, Ont.
William O'Brien is having plans prepared for a reinforced concrete silo.

Morkin Bros. are considering remodelling their farm buildings. Work will include cement foundations and interior alterations.

Whitby, Ont.
The by-law providing for certain concessions to the Whitby Silk Mills Company has been carried, and the Company will now proceed with the erection of a factory. Estimated cost, $50,000.

CONTRACTS AWARDED

Dartmouth, N.S.
The contract for steel required in the erection of a plant for the Williston Steel & Foundry Company, 504 Robie Street, Halifax, has been awarded to the Maritime Bridge Company, New Glasgow, and for engines to the Starr Manufacturing Company, Dartmouth, N. S. Tenders for other trades will be called about February 2nd.

Hamilton, Ont.
The contract for carpentry required in the erection of an addition to a factory on Sherman Avenue for the Canadian Cartridge Company, 161 Oak Avenue, has been awarded to the general contractors, H. G. Christman Company, Bank of Hamilton Building.

The Burlington Steel Company, Sherman Avenue, have awarded the general contract for the erection of an addition to their factory to the H. G. Christman Company, Bank of Hamilton Building. Steel and brick construction, concrete foundation. Approximate cost, $5,000.

Montreal, Que.
The contract for glazing and painting at the Parisien Hotel, now in course of construction for T. Bastien, 5 Beaver Hall Square, has been awarded to Valentine & Guilbault, 137 St. Maurice Street.

The following contracts have been let for alterations to the store of the Walk Over Shoe Shop, 521 St. Catherine St.:—carpentry, D. F. Sheehy, 16 St. Cecile Street; tile and marble work, G. R. Locker Company, 143 Mansfield Street; store fronts, H. J. St. Clair Company, Limited, 69 Yonge Arcade, Toronto, Ont.; plate glass, Consolidated Plate Glass Company, Limited, 30 St. Sulpice Street.

The contract for roofing required in connection with the factory which has been built for the Steel Company of Canada, 1272 Notre Dame Street West, has been let to Campbell, Gilday Company, Limited, 793 St. Paul Street W., and the heating to Thomas O'Connell, 183 Ottawa Street.

Ottawa, Ont.
Work is progressing on alterations to the old Royal Bank Building for Darwins, 81 Sparks Street. The contract for interior work has been awarded to A. Christie & Son, Kenniston Apartments, the contract for flooring to the Montreal Wood Mosaic Flooring Company, 672 St. Catherine Street West, Montreal, and for store fronts and glass to H. J. St. Clair Company, Limited, 69 Yonge Arcade, Toronto, Ont.

Toronto, Ont.
The general contract for alterations to the warehouse of the William Rennie Company, Limited, 130 Adelaide Street E., has been awarded to Alexander & Son, 457 Church Street, and work has been commenced. Approximate cost, $10,000.

Windsor, Ont.
In connection with the alterations which are now being carried out at the Dougal Block for Simon Meretsky, Mercer Street, the contract for plastering, painting and electrical work has been let to the general contractors, Scully and Humphries Construction Company, Free Press Building, Detroit, Mich.

Yorkton, Sask.
The Yorkton Creamery Company have let a contract for a cold storage installation at their premises on Lauria Street to the Linde Canadian Refrigeration Company, 909½ Main Street, Winnipeg.

Residences

Avonbank, Ont.
A. Ready, St. Paul's Station, will commence the erection of a residence in the spring. Pressed brick construction.

Brooklin, Ont.
W. A. Dryden is having sketch plans prepared for a residence, estimated to cost $5,000. Tenders may be called in the spring. Brick construction.

Kingsville, Ont.
Wigle & Wright are considering the rebuilding of the residence which was recently destroyed by fire.

London, Ont.
All work required in connection with the residences which are now being erected by the Copp Syndicate will be done by the owners. Secretary, A. M. Hunt, Dominion Savings Building.

Montreal, Que.
Work has been started by Owen Roberts, 112 Addington Avenue, on the erection of twelve flats on Wilson Avenue. Brick construction, concrete foundation, felt and gravel roofing. Approximate cost, $18,000.

J. A. Bray, 6375 Berri Street, is receiving tenders on all smaller trades required in the erection of three flats on St. Denis Street. Brick construction, concrete foundation, felt and gravel roofing. Estimated cost, $7,000.

Ottawa, Ont.
A. W. Davidson, 69 Grosvenor Street, has commenced the erection of a residence on Hopewell Avenue, estimated to cost $4,000.

St. John, N.B.
R. A. Corbett, 274 Douglas Avenue, has commenced the erection of apartments, estimated to cost $3,000. Frame construction, concrete foundation, asbestos roofing.

Tillsonburg, Ont.
F. K. Wilson, Bidwell Street, is considering repairs to his residence.

Toronto, Ont.
George Edwards, 1028 St. Clair Avenue W., has commenced the erection of a pair of residences at 209 Lauder Avenue. Smaller trades will be let. Brick construction, shingle roofing. Estimated cost, $6,000.

Work has been started by F. H. Miller, care of Miller & Sons, Lauder Avenue, on the erection of two residences, estimated to cost $5,500. Smaller trades will be let. Brick construction, shingle roofing.

Whalen, Ont.
Plans are being prepared by James Kelly, Cedar Swamp Farm, for the erection of a residence. Frame and white brick construction, stone and concrete foundation, shingle roofing. Estimated cost, $3,000.

John Foster is having plans prepared for a residence, estimated to cost about $3,000. White brick construction, stone and concrete foundation, shingle roofing.

Plans are in progress for a residence to be built for Richard Hodgins. White brick construction, stone and concrete foundation, shingle roofing. Approximate cost, $3,200.

Wolfville, N.S.
Clark Gormley contemplates the erection of a tenement block in the spring. Frame and stone construction, concrete foundation, wood roofing. Estimated cost, $5,000.

CONTRACTS AWARDED

Fort Erie, Ont.
E. W. Near has commenced the erection of a residence on River Road for J. B. Ernsmere. Frame construction, concrete foundation, shingle roofing. Approximate cost, $3,000.

Maisonneuve, Que.
In connection with the residence which is being erected on LaSalle Avenue by J. T. Legault, 30 St. James Street, Montreal, the contract for plastering has been awarded to D. Thibault, 610 Orleans Avenue, and the electrical work to J. A. Gagnon, 733 Notre Dame Street.

Walkerville, Ont.
The following contract have been let in connection with the residence now being built on River Front for T. McGregor, 239 Brush Street, Detroit:—carpentry and roofing, W. Dupuis, 147 Dougall Avenue, Windsor; painting, Chauncey Bennett, 22 Assumption St.; heating, Windsor Hardware Company, 71 Sandwich Street E., Windsor; plumbing, Pennington & Brian, 47 Sandwich Street W., Windsor; electrical work, Gas & Electric Supply Company, 20 Sandwich Street W., Windsor.

Windsor, Ont.
The contract for heating required in connection with the terrace which has been erected for Mrs. E. M. Rolph, 22 Bruce Avenue, has been awarded to Philip Dresch, 2 Ontario Street, Walkerville.

In connection with the residence erected for John Hubner, 188 Dougal Avenue, the heating contract has been let to the Windsor Hardware Company, 71 Sandwich Street E.

The general contract for the erection of a residence for J. L. Ouellette, 59 Campbell Avenue, has been awarded to A. L. Ouellette, 110 Goyeau Street. Brick construction, concrete foundation, shingle roofing. Approximate cost, $4,500.

Power Plants, Electricity and Telephones

Brantford, Ont.
A by-law has been carried authorizing the sale of the Galt-Paris portion of the Brantford to Galt Municipal Railway to the Lake Erie & Northern Railway. The latter Company will now electrify their road from Galt to Port Dover.

Gravenhurst, Ont.
The by-law authorizing the changes to the street lighting system has been carried and the work will be done under the supervision of the Commission. Town Clerk, W. H. Butterworth. Approximate cost, $3,500.

Noelville, Ont.
W. Davurt is considering the construction of a telephone line between Rutter and Monetville.

Sarnia, Ont.
A by-law has been carried to provide for the installation of a hydro electric system. City Clerk, James D. Stewart.

A by-law has been carried authorizing the purchase and remodelling of the generating plant and distributing system of the Sarnia Gas & Electric Light Company at a cost of $120,000.

Sherbrooke, Que.
The City Clerk, E. C. Gatien, will receive tenders until noon, January 17th, for the supply of transformers. Specifications, etc., at office of the Clerk and of the Engineer, M. A. Sammett, 301 McGill Building, Montreal.

The City Council have awarded the contract for alterations to the power plant to the Jenckes Machine Company, Limited, Lansdowne Street. Approximate cost, $3,740.

Toronto, Ont.
The Board of Control will receive tenders until February 1st on the supply of a number of street cars and equipment and a quantity of copper cable. Specifications, etc., at Room 12, Works Department, City Hall.

The Goldie & McCulloch Company, Limited, Traders Bank Building, are in the market for one direct connected generator, including engine, 25-50 volt, direct current.

Wellesley, Ont.
A by-law has been carried authorizing the borrowing of $7,500 for the construction of an electric light and power distribution plant.

Fires

Caraquet, N.B.
The Sacred Heart College has been totally destroyed by fire. Loss, $250,000; insurance, $100,000.

Cassilis, N.B.
Fire has entirely destroyed the residence and outbuildings owned by Mrs. John Menzies. Loss, about $3,000.

Clinton, Ont.
The store owned by F. H. Powell has been destroyed by fire. Loss covered by insurance.

Fort Frances, Ont.
Fire has destroyed the store owned by G. A. Stephen, Scott Street. Loss is considerable.

Kingsville, Ont.
A residence on Division Road, owner by Wigle & Wright, has been destroyed by fire.

Les Eboulements, Que.
Fire has destroyed the residence of Amede Bergeron. Loss covered by insurance.

Low Point, N.S.
The Roman Catholic Church has been completely destroyed by fire. Loss, about $25,000, partially covered by insurance. Steps will be taken at once to rebuild. Pastor, Rev. Father McAulay.

Middle Sackville, N.B.
The residence of James McInnis has

been destroyed by fire. Loss, about $2,000, partially insured.

Fire has entirely destroyed the store owned by James Smith and occupied by Tillman A. Cormier.

Napanee, Ont.
The residence of F. Asselstine, Isabella Street, has been entirely destroyed by fire.

Quebec, Que.
The factory of the Rock Shoe Manufacturing Company, 166 St. Helene St., has been destroyed by fire. Loss, $75,000, insurance $35,000.

Fire has done considerable damage at the Quebec Seminary. Proctor, Rev. Odilon Gosselin.

The residence of E. Lamontagne, Domaine Lairet, has been destroyed by fire. Loss, $6,000, covered by insurance. Owner will probably rebuild.

Sackville, N.B.
A residence owned by Charles Fawcett Company, Limited, Main Street, has been totally destroyed by fire.

St. Jerome, Que.
The flour mill owned by Edmond Langevin has been destroyed by fire.

St. Joseph, Que.
Fire has destroyed the hotel belonging to Thomas Cliche.

Sydney, N.B.
The hotel owned by the King George Hotel Company has been completely destroyed by fire. Loss, $70,000, partially covered by insurance.

Thorold, Ont.
The store and residence belonging to C. Geracitani has been entirely destroyed by fire. Loss, $5,000, covered by insurance.

Miscellaneous

Chatham, Ont.
The by-law to provide for the expenditure of $15,000 on the purchase of fire equipment has been defeated.

To Study Advantages of Use of Hydrated Lime in Concrete

To determine if the claims that the addition of hydrated lime to concrete increases its plasticity, decreases segregation and improves its waterproofing qualities are justified, the U. S. Bureau of Standards will make tests on such concrete. Before entering into the work an advisory committee, composed of representatives of the four interests involved—the cement industry, the lime industry, the engineer and the contractor—was asked to participate in outlining plans for the work. This committee, which was selected by P. H. Bates and W. E. Emley (of the Bureau of Standards), who will have active charge of the work, met in Pittsburgh, November 4, and offered criticisms of the plan of work prepared by the Federal bureau. As a result the programme was modified to meet such criticisms insofar as was advantageous, and it is expected that the research will be started during the present month.

As outlined, the work is extensive in scope. The tests will include: Determination of compressive strength, expansion, reinforcement, permeability, action of sea water, the hydration of cement, absorption, segregation, abrasion and adhesion of cement to reinforcement. Specimens to which varying proportions of hydrated lime have been added up to five years of age will be tested.

Cover Steam Pipes to Save Coal

One reason for coal costs in the power plant of a clay works being higher than they should be, is found in insufficient covering on steam connections. The proper insulation of steam pipes is important. For instance, in one industrial establishment in a main sixty feet long, the steam was found to contain thirty-one per cent. of moisture. After covering the pipe with a good heat-insulating material, this percentage was reduced to three and six-tenths.

Among the best of the substances available for this purpose are hair-felt, slag-wood, magnesium and asbestos. Hair-felt, while unexcelled as a non-conductor, quickly chars unless protected from actual contact with the piping, by a wrapping of asbestos paper or other non-burnable material. Slag wool, on the other hand, is fireproof. A covering compound of which asbestos fibre is the base, enjoys considerable popularity. It has the advantage of being in convenient form to apply, and also may be used over again. Water, obviously, should not be allowed to drip on the covering, as it not only may soften it so as to cause it to drap off, but a wet covering is a very poor retainer of heat.

Tenders and For Sale Department

Concrete Mixers

Large company in Middle States making concrete mixers wants selling agents for Canadian territory. Good working arrangement and substantial assistance will be given to reliable aggressive agents. Box 279, Contract Record, Toronto, Ont. 1-4

Quarry Machinery Wanted

Two gang saws and one planer in good working order.

F. ROGERS & COMPANY,
1193 Queen Street West,
Toronto, Ont.

1-2

School Tenders

Tenders for all trades in connection with the erection of addition to St. Joseph's, St. Clare's, and St. Anthony's Separate Schools and new school for St. Monica's Parish, for the Separate School Board for the City of Toronto, will be received until 5 p.m., **Wednesday, January 26, 1916**, at the office of the Board, 67 Bond Street.

Tenders to be submitted on forms supplied and to be addressed to E. F. Henderson, Chairman of Sites and Buildings Committee, and to be accompanied by a marked cheque for 10 per cent. of the amount of tender.

Plans and specifications may be seen at the office of the Architect, Charles J. Read, Rooms 203-4 Confederation Life Building, Toronto.

52-2-3

Tenders for
STREET CARS

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon, on **Tuesday, February 1st, 1916**, for the supply and delivery of:-

	Tender Numbers
Street Cars, Complete	70
Street Car Bodies	70-A
Street Car Trucks	70-B
Street Car Motor Equipment	70-C
Street Car Air Brake Equipment	70-D
Copper Cables for Street Car Work	70-E
Street Car Fare Boxes	70-F

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman, Board of Control.

Toronto, December 30th, 1915. F

Notice to Contractors

Cast Iron Pipe

Sealed tenders, addressed to the Chairman of the Water Works Committee, will be received by registered post by the Secretary of the Water Works Committee, City Hall, Ottawa, up to 4 p.m., **Monday, January 24th, 1916**, endorsed "Tender for Cast Iron Pipe."

Any tender received after the above stated time will be declared informal.

Specifications and full information may be obtained on application to the City Engineer's Office.

The Corporation does not bind itself to accept the lowest or any tender.

R. L. HAYCOCK,
Acting W. W. Engineer.
City Hall, Ottawa,
January 10th, 1916. 2

Late News Items

Calgary, Alta.
A petition has been presented to the City Council asking for the construction of a concrete bridge over the Bow River at Ninth Street W. Clerk, J. M. Miller.

Cobden, Ont.
A by-law has been carried authorizing the expenditure of $20,000 on the purchase of a site and the construction of plant and equipment for a hydro electric system. Clerk, J. R. Warren.

Grand'Mere, Que.
The Town Council have extended the time for receiving tenders on the supply of electrical equipment until January 14th. Secretary, Louis Berube.

Grey Township, Ont.
The Trustees of School Section No. 10 are considering the erection of a school at an approximate cost of $5,000. Architect not yet appointed. Secretary, William Whitfield, Brussels, Ont.

Halifax, N.S.
Work has been started on the construction of a wharf for the Furness Withy Company, Water Street. The masonry, carpentry and roofing contract have been awarded to the general contractors, Nova Scotia Construction Company, 159 Upper Water Street. Remaining contracts will be let in the spring.

Hepworth, Ont.
A by-law has been carried providing for the loan of $12,000 to the Hepworth Silica Pressed Brick Company, Bruce Street, for the construction of a brick manufacturing plant. Manager, C. S. Block.

Highgate, Ont.
Plans will be prepared at once for the installation of a hydro electric system, estimated to cost $7,000. The by-law authorizing the construction has been carried.

North Caradoc, Ont.
The erection of a school is being considered by the School Trustees. Estimated cost, $5,000. Architect not yet appointed. Reeve, T. G. Turnbull, Komoka, Ont.

Regina, Sask.
The Imperial Oil Company, Limited, Dominion Bank Building, Toronto, have secured a site between Winnipeg Street and the Canadian Pacific Railway, and propose to commence immediately the construction of an oil plant. The railway companies are making arrangements for the construction of the necessary trackage and the city for sewers and watermains. Approximate cost, $600,000.

Sault Ste. Marie, Ont.
The brick residence owned by A. C. Boyce, M.P., has been destroyed by fire. Loss is heavy.

Shawville, Que.
Tenders on the installation of interior fittings at the Post Office will be received until 4 p.m., January 18th, by R. C. Desrochers, Department of Public Works, Ottawa. Plans and specifications with John Shaw, Clerk of Works, Shawville, and at the Department.

Woodstock, Ont.
The by-law providing for the construction of extensions to the storm sewer system has been carried. Work will probably be carried on during the winter. Engineer, J. F. Ure. Estimated cost, $25,000.

Wyoming, Ont.
A by-law has been carried authorizing the construction of a hydro electric system at an approximate cost of $6,000. Plans will be prepared at once and work will commence in the spring. Town Clerk, H. G. Taylor.

Cut Down the Water Bill

For plants that are using town or city water, one way to cut costs is to obtain a private source of supply. A company in Dayton, Ohio, recently saved enough in only a few months, after installing its own deep well and pumps, to pay for the equipment.

Not always can water be secured in this way which is as well suited to boiler use or for tempering as the municipal supply, but when the quality is satisfactory, the saving is likely to be considerable. Then, too, with a private supply there is an added security that comes of having an independent source in case of fire.

Deep wells are often pumped by compressed air. The method is known as the air lift. In this, an air line within the well pipe discharges compressed air at the bottom of the well. These air bubbles lift the water with them as they rise to the outlet pipe.

Sands and solids in the water are no detriment with the air lift pump. In fact, the air lift draws them out and thus enlarges the water bearing cavity and so increases the flow of water.

ESTABLISHED 1886

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Vol. 30 **January 19, 1916** **No. 3**

Principal Contents

Politicians vs. Engineers

"The politicians of Canada are going to get a jolt in the next ten years and it is going to come from the engineers"

This is the recently expressed opinion of a business man of the city of Ottawa—the centre of Canadian political activities, intrigues and trickeries, the scene of extravagant spending of the Canadian people's money, the home of incompetence in the discharge of the Canadian people's business. Politicians! This word is associated today in Canada with all that is loathesome to the honest business man. The very scorn of it keeps worthy men from offering their services to their country. It is the final anathema hurled at an enemy when all other words in the English language fail to reach their mark.

The individuals who at election time aspire to "attend to" the business of our country naturally fall under four fairly distinct sub-headings. These are: dishonest incompetents, honest incompetents, dishonest competents and honest competents. The first do as much harm as they can, the second would have our sympathy if we did not have to bear the consequences, the third class represent a very real and dangerous enemy of our country's well-being and the fourth—get defeated at the polls.

The question before the Canadian people plainly is then: How can we increase that fourth class—honest competents—and everything points to the engineering profession. To begin with the engineer is, by training and experience, efficient,—the first requisite of a successful business man whether in private or public affairs. And next, he is honest, from the very nature of his calling. An engineer is an engineer because that particular work had more attraction for him than a business in which the sole or main object is the making of money. And, after all, it resolves itself largely into this—that the man whose ideal in life is "money" has no possible right in our legislative halls.

Will the engineer step in to fill the gap? We hope so. There is no doubt of his fitness. But the country is still shackled with the iron chain of "party" politics—the system that pre-supposes dishonesty and incompetence in that it appoints one man to an office and a second man to watch him. The engineer stands for competence and honesty. Does our country want them?

More Detailed Specifications

MR. O. W. SMITH, in his article on "specifications" reproduced on other pages of this issue, voices once more the ever-recurring protest against the incomplete specification. The difficulty of obtaining fully detailed information as to what is really wanted when bidding on work is one of the serious problems which confronts the contractor. Information of local conditions, for instance, which often has an important bearing on the ultimate cost of the work, is not included in the specifications, even when it is in possession of the designer or the engineer, and the contractor is left to shift for himself and get, as well as he can, such information.

In the ordinary class of straight contract in which the parties are bound within definite and prescribed lines, too much care cannot be taken in drafting the specification which becomes a vital part of the contract. The chief duties of the specification are to define or describe the work, so that any competent contractor may submit an intelligent bid, and to establish a guide and a standard by which the contract may be interpreted to each party. We often find, however, as already stated, that detailed information is not fully given. It is the duty of engineers or writers of specifications to provide positive information of local conditions pertaining to the work above ground and below. The time allotted to the contractor is often too short to admit of anything but a brief survey of conditions and he has to practically guess about conditions which are of vital importance. Clearness, brevity and consistency are three things to be attained in wording a specification. Tautology should be avoided.

To establish a guide and a standard by which the contract may be interpreted with fairness to each party several things are essential, such as—a complete list of quantities of all work, a schedule of unit prices of all items in the work, a schedule of prices for all extra work, and all items in the schedule of prices should be adequately covered by a corresponding clause or section on the specification. Bidders should not be required to estimate their own quantities. The bidder, while perfectly competent to construct the work, may not be expert in calculating quantities.

The gist of the matter is to give all the necessary information in a specification, whether it be description of work and material, local conditions, quantities, matters of extra work, etc., and to have it properly expressed so that all bidders may precisely and explicitly know what is required of them. The more doubtful a bidder is as to what is expected of him, the greater the sum he will add to his price for contingencies which may arise.

The penalty clause should be used only in exceptional cases where it is an absolute necessity to complete within a certain time. It seems ridiculous to have a time penalty clause placed indiscriminately in all contract specifications, when in nearly all cases the contract will be carried out along the usual lines as rapidly as possible.

During the process of developing specifications it would appear that the general clauses, relating to the rights, duties, and obligations of the contracting parties, and the engineer or owner, have received more cultivation than the specific clauses, relating to the description of the work, whose accomplishment is the object of the contract. No one will object to the proper safeguarding of the interests of the owner or public but this can best be done by a fair bargain in which each party knows thoroughly what is required, and each makes himself responsible for his own particular part of the contract, agreeing on a fair method for adjusting unforeseen contingencies which are usually bound to occur.

Hardwood Floors in Fireproof Buildings

In discussing floor surfaces in fireproof buildings in a paper read before the American Society of Mechanical Engineers, Sanford E. Thompson pointed out the kinds of hardwood floors best adapted for the purpose and also the method of laying them. The following extracts from the Architect and Engineer are likely to prove of interest:

Floors of maple, birch, beech, oak, or long leafed Southern pine are used most largely for offices, class rooms, or lecture rooms, and in many of the older colleges for laboratories and halls. A wood surface, however, is not usually considered entirely satisfactory, either in general appearance or in wearing qualities. If one passes from a corridor with a granolithic, terrazzo, or tile floor, into a room or auditorium having a wood floor, there is a marked effect of inferiority and cheapness.

There is just as much danger of poor materials and workmanship with wood as with other kinds of floors. Unless the greatest care is taken in selection of materials and workmanship, they are liable to shrink or swell and sometimes to squeak under foot. If at all hollow underneath, they are more noisy than a concrete surface.

For corridors, wood is being largely superseded by granolithic, terrazzo, or tile. For laboratories other materials are being substituted for wood in most of the newer structures, although wood is occasionally preferred, especially for physical laboratories and for laboratories where men stand for long periods. The linoleum on concrete will overcome practically all the objections that are made to wood floors, with a cost substantially the same.

There are various methods of laying hardwood floors. For class rooms a single thickness of maple or birch nailed to sleepers with cinder concrete between should be satisfactory. Another type of construction is to use patented metal screeds embedded in the base concrete, and nail the floor boards to splines in the screeds. For rooms subjected to heavy traffic, 2-inch or 2½-inch plank may be placed underneath the hardwood floor.

Of all the different materials, oak is the most expensive and the finest in appearance at the beginning, but under heavy traffic is more liable to splinter than the finer grained woods. Georgia pine, if of best quality, makes a durable floor, and is preferable to the finer grained woods in wet places, as it does not swell and warp so badly. It is less durable, however, and therefore not recommended for the greatest permanence in rooms such as class and lecture rooms. Maple, birch and beech all make good floor material. These are usually laid in strips ⅞ in. thick by 2¼ inches wide.

Annual Report for the Municipality of South Vancouver

The annual report of the municipality of South Vancouver, on the work carried out under the Board of Works (S. B. Bennett, municipal engineer) has just been presented.

Street Improvements

The following summary represents the work done on street improvements in 1915:—

	Lineal Feet	Miles
Streets cleared and rough graded	2,230	.422
Lanes cleared and rough graded	4,180	.791
Streets graded	7,430	1.407
Lanes graded	740	.141
Streets macadamized	9,710	1.839
Streets planked	2,270	.430
Lanes planked	.150	.028
Planking removed	3,600	.681
Bulkhead in place	1,040	.197
Three-plank walks	400	.076
Box drains laid	842	.500
Rock broken ... cu. yds.	3,316	

Waterworks

The waterworks department reports operations during the year and the cost as follows:—

Construction		
12-in. Mains	3,853 ft.	
8-in. Mains	1,110 ft.	
6-in. Mains	4,815 ft.	
4-in. Mains	1,130 ft.	
Temp. Mains	5,255 ft.	
Hydrants	25	
		$18,964.16
Services (including all transferred)	120	1,271.36
Meters (including all transferred)		282.39
Operating		9,966.00
Maintenance		7,449.41
Lowering Mains		1,444.61
Total		$39,377.93

Sewers

The work carried out under the sewer committee for the year ending 1915 is summarized as follows:—

Manitoba Street outfall	2.865 miles pipe laid
George Street outfall	1.888 miles pipe laid
Glen Drive outfall	.082 miles pipe laid
Total	4.835 or over 4¾ miles
Concrete manholes completed	74
Concrete lampholes completed	16
Sewer permits issued	158
Connections to houses, completed	94
Stand pipes put in place	22

Quantity Surveyors

Our recent remarks re quantity surveyors have occasioned some surprise in England where they have been noted by engineering journals in their editorial columns. The Surveyor has the following:—

"The special function of the quantity surveyor in British architectural practice is so well defined, and its utility is so well recognized, that it is rather surprising to learn from a recent issue of the Contract Record of Toronto that the term 'quantity surveyor' is a new one in Canada. The arrival at Winnipeg of Mr. Hugh Watkins, the well-known London quantity surveyor, who is acting professionally in connection with the erection of the new Parliament buildings, is apparently so much of a novelty as to merit special comment. The present practice in Canada, even in the case of buildings of first-class importance, is for each contractor who intends to submit a tender to prepare his own quantities from the drawings and specifications received from the architect. The absurdity of duplicating work in this way, and the greatly increased chance of error arising from the impossibility of a contractor's estimating clerk exercising the care and skill of a professional surveyor are manifest; and Mr. Watkins believes that in the near future the British practice will become general throughout the Dominion. Commenting generally on the subject, our contemporary points out that under the old system, if twenty contractors tender for a given work, nineteen useless bills of quantities are prepared, all of which have to be paid for by someone in the long run in the form of increased establishment charges in the contractor's business. Moreover, a full bill of quantities prepared by an independent surveyor has a further advantage for all parties, in that it forms a reliable basis upon which extras and deductions can be calculated."

And this from the Building News:

"We are glad to note that Mr. Hugh Watkins, quantity surveyor, of London, has arrived in Winnipeg, and that he and his two assistants have commenced their duties in connection with the New Parliament Buildings, which are being erected from the designs of Mr. F. W. Simon, F.R.I.B.A. Quantity Surveyors hitherto have been unknown in Canada, but a strong movement is on foot to insist on their employment, as in this coutnry, for all buildings of any importance. Under the existing system in Canada an architect is engaged to prepare the necessary drawings and specifications, which are forwarded to each contractor who has signified his intention of tendering for the work. Each contractor then sets to work to prepare the necessary measurements of materials and labor to enable him to arrive at the amount of his tender. This does not apply to buildings alone. At the present moment a Canadian city is calling for tenders for a gravity filtration plant—plans and specifications to be furnished by the contractor. Thus, assuming twenty contractors tender for a job, nineteen sets of quantities are useless and waste labor. One result, of course, is that careful and accurate estimates are rare, and another that no reliable basis exists on which any extras or deductions can be arrived at."

The big obstacle, as we see it in Canada, to the more general employment of a quantity estimator, is in placing the responsibility in case of an error in estimating. The contractor plainly should not bear the added expense, the estimator probably could not and so it must fall on the shoulders of the owner.

If outstanding contracts are filled, and the war continues throughout 1916, it seems clear that during 1915 and 1916 there will have been spent in Canada for war supplies considerably more than $500,000,000.—Sir Edmund Walker, at annual meeting Bank of Commerce.

"On Doing Your Bit"

By Bill

The war is slowly but steadily pushing on, month after month passes by and no decisive victory has at present been achieved, but we are full of optimism, for lots of young fellows we know are "doing their bit" and doing it well.

It may be a somewhat pertinent question but just put it to yourself now. "Am I doing my bit" and if not, why not?

There are some amongst us too old, too short winded, and others too apathetic to do their share in this gigantic struggle.

The single young fellow whether he be rodman, instrument man, or assistant engineer is missing the opportunity of his life, if he is not now in khaki.

The young Canadian is as anxious to show his loyalty as the Australian or New Zealander, and we must all be prepared to make any sacrifice to do our duty for our king and Country.

But look again, just think of the experience to be gained. The young Canuck on his return would be able to talk of the wonders of the Old Country, of France and Belgium and possibly of having shared in that greatest of all honours, viz., the entry of the Allies in Berlin. Then a little later when he may be discussing pavements, boulevards, street lighting, &c., he would be able to turn to his committee saying, "You know when I was in Paris I inspected the Rue de Joffre; it is paved with wood blocks on concrete base and is in excellent condition," or, "In Antwerp I noticed that the pavements were not so good as in London." While the younger members of the staff would simply gaze with wonderment and admiration at the man who could discuss with such ease the geological formation of France, Flanders or the Dardanelles.

The King's medal with bars and ribbons and, possibly, a D. S. O., would cause the directors of the company or corporation to tread lightly and with reverence as they approached his drafting table, and the very fact of being able to say "In my younger days when I was with my friend French," or "In my last interview with Kitchener," would make the most autocratic councillor turn green with envy.

Bishop Strachan School, Toronto

New Residential School for Girls on College Heights—Collegiate Gothic Style—Carefully Designed to Meet Modern Educational Needs

AFTER a long and honorable career in the buildings now so familiar to present and former pupils it was decided several years ago to move the Bishop Strachan School to another site farther north, where modern buildings, large enough to accommodate the ever-increasing number of pupils, might be erected. Accordingly the council acquired a most suitable and beautiful location on College Heights. The new site comprises a whole block of a little over seven acres, bounded by Lonsdale Road and Russell Hill Road on the south and west and by Frybrook Avenue and Warren Road on the north and east. On this new site has been erected a handsome building, carefully designed to meet modern educational needs, and to furnish the most complete equipment in every department.

The structure is built of grey Credit Valley stone and the architecture is in the Collegiate Gothic style. The school and residence form two sides of a quadrangle, connected at one end by the Assembly Hall and at the other end by a wing including a double row of music rooms and domestic serving apartments.

The general plan of the building has the great advantage of securing a double south aspect, by the use of the quadrangle in the centre of the building. The main south facade on Lonsdale Road has a length of 285 feet and the west front on Russell Hill Road a length of 240 feet.

The north wing, or residence, and the west wing are four stories high, while the south wing or school building is three stories, exclusive of the basement.

On the east side of the quadrangle is a large Assembly Hall 32 ft. 6 in. by 87 ft. 7½ in. and approximately 30 ft. high, with a seating capacity of 400 persons, and with a platform space of 33 ft. 6 in. by 14 ft. 6 in.

Basement

The basement plan, while not totally excavated to the size of the first floor plan, contains junior and senior cloak rooms and toilet rooms under the east and south wings. The west wing is given over to the domestic apartments necessary to carry on such an institution, and in the northwest corner is a large gymnasium. The domestic service equipment includes kitchen, bakery, dairy, laundry, fruit, vegetable and meat departments, etc. A large dining room for the servants is provided in the southwest corner. The gymnasium in the northwest corner is 69 ft. 6 in. by 24 ft. 6½ in. A swimming pool, 28 ft. by 13 ft., is provided, with showers and dressing rooms situated in the north wing.

First Floor

In the south wing on the first floor is the principal's office with a waiting room to the right of the main hall and a staff common room to the left. Across the corridor, running at right angles to this hall, are class rooms, see plan herewith. In the west wing are modern laboratories for the classes on domestic science, the junior dining room, the servery and the main dining room which is directly over and similar in floor plan to the gymnasium below. Food is prepared in the basement and elevated to the servery by a dumb waiter and served from here to both dining rooms. In the north wing are two large dormitories and two spacious study rooms in which the students may spend their spare time or study hours. The east wing is mainly taken up with the Great Hall, or Assembly Room.

An important feature of the building is the number of piano practice or music rooms; there are fifteen on the first floor on the east and west sides of the

Bishop Strachan School, west front and south facade, showing main entrance.

quadrangle and eight on the second floor on the west side of the quadrangle. In the construction of these rooms every known device for deadening sound has been employed.

Second Floor

The second floor plan is taken up entirely by dormitories in the west and north or residence wings with class rooms in the school wing. Directly over the main entrance on the south is a spacious library. The science laboratories are on this floor in the southwest corner.

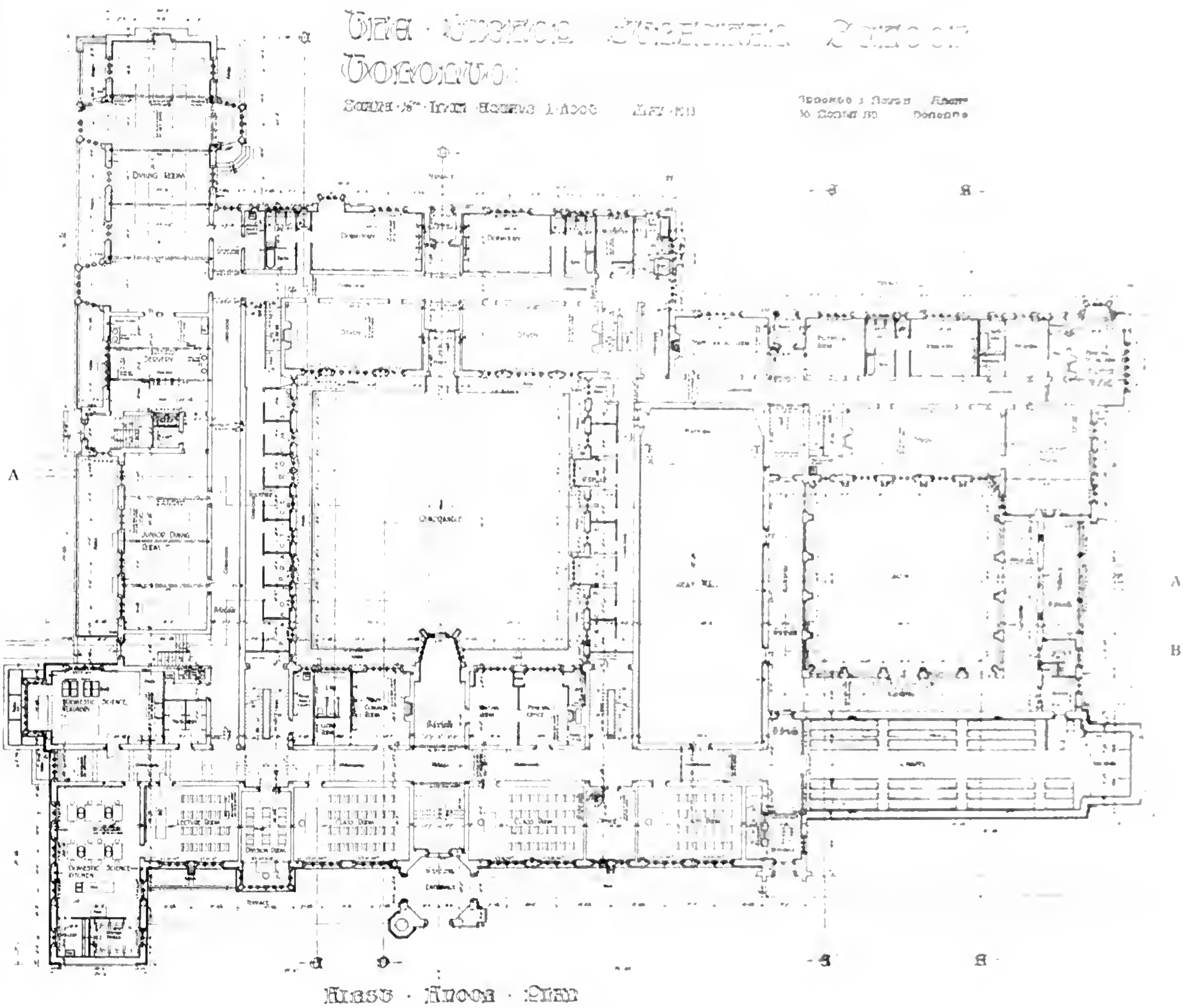
Third Floor

The third, or top floor, plan of the school wing is taken up by studios fitted with skylights and good northern light for art purposes.

The fourth, or top floor, plan of the north, or residence, wing is given over entirely to bedrooms.

Equipment

The buildings are heated by the most modern hot-water system, in which the water is pumped through the pipes by turbine pumps; ensuring perfect circulation. The water returns to the pumps with only 3 degrees loss in temperature in passing through a half-mile of pipes. For hygienic reasons this system was preferred to steam heating, as the heat given off from hot water radiators is of lower temperature and does not deplete the air of its natural humidity. The heating plant is in a separate underground building to the northwest, the water being brought to the school by an underground tunnel, a plan which makes for both safety and comfort.



Layout of first floor plan Bishop Strachan School, Toronto.

In the construction of the building every care has been taken to guard against danger of fire. The building is constructed of grey sandstone, with copings, facings, cornices and window casements of finished cut stone; leaded glass and steel sashes are used throughout the building.

The floors for the most part are 7/8 in. beech, laid on strips on 7/8 in. rough flooring. In the basement, corridors, toilet rooms, etc., 1/2 in. granolithic finish on 4 in. of concrete is employed. The interior finish is dark stained oak with seats, desks and other interior furnishings to match. The main roof of the building is felt and gravel, with green slate shingles on eave slopes.

A notable feature in the building construction is the lighting. Special attention has been paid to the

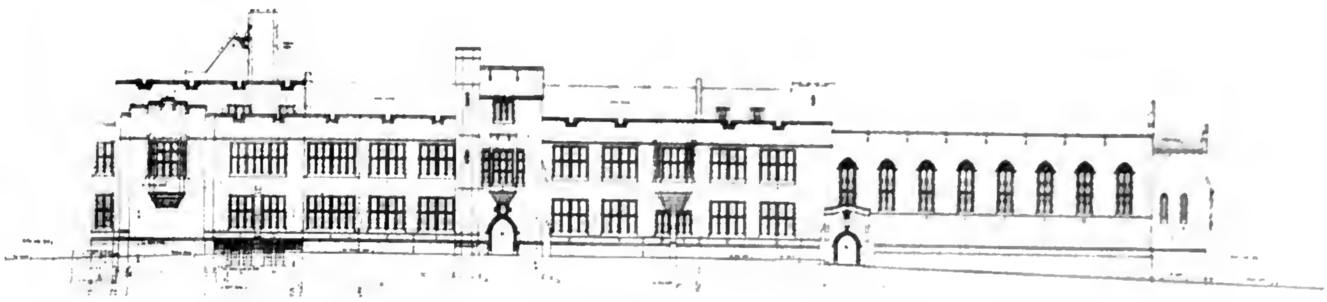
Art Studio—Bishop Strachan School.

lighting of the rooms, both by day and night; this is at once evident by the great number of windows, which are large and well placed so that the rooms enjoy a generous flood of sunlight during the day.

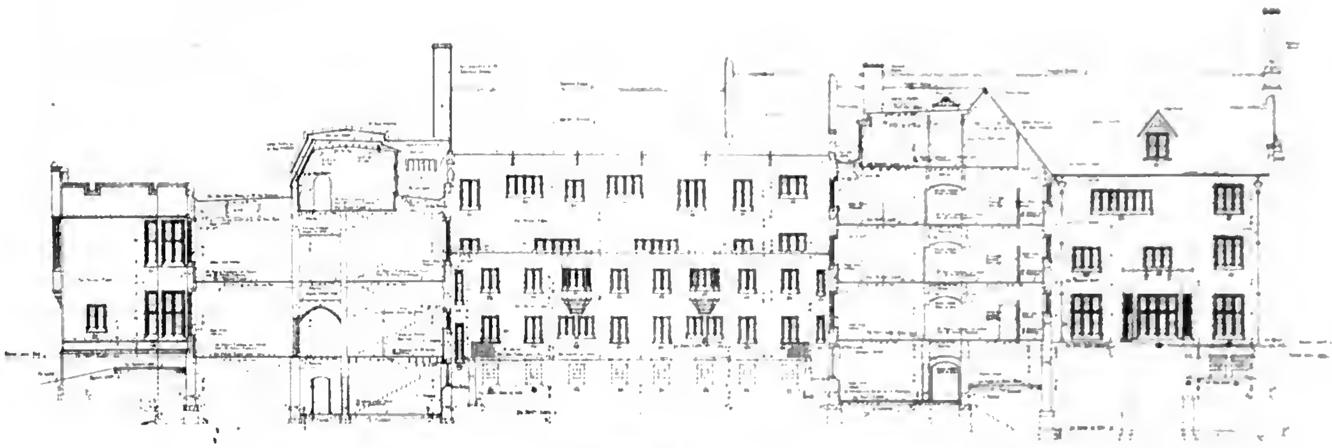
The ventilating has also been given a great deal of consideration, necessary on a building of this kind, and has been worked out to ensure an adequate supply of fresh air at all times. A further special feature is a refrigerating plant, installed so that the school may have cool rooms to properly care for its food. They manufacture their own ice, thereby eliminating any danger of diseases from the use of impure ice. In all these matters the health and comfort of the pupils has been the first consideration and no expense has been spared to secure the best results. The building, which is now occupied, was designed by Sproatt and Rolph, architects, and was built by the following sub-contractors: masonry, Page & Co.; carpentry, A. Weller & Co., Ltd.; heating, W. J. McGuire, Ltd.; wiring, Bennett & Wright; electric fixtures, R. A. L. Gray; steel sash, Henry Hope & Son; painting, Faircloth Co., Ltd.; roofing, Duthie & Son; interior furnishings, Murray-Kay, Ltd.; kitchen equipment, Geo. Sparrow & Co.

The Imperial Munitions Board have given orders in Canada for 22,800,000 shells, having a value of $282,000,000. If we add to this the orders for cartridge cases, primers, forgings, friction tubes, etc., a total of $303,000,000 is reached. —Sir Edmund Walker, at annual meeting of Bank of Commerce.

Assembly Hall—Capacity 400 persons.



South · Elevation



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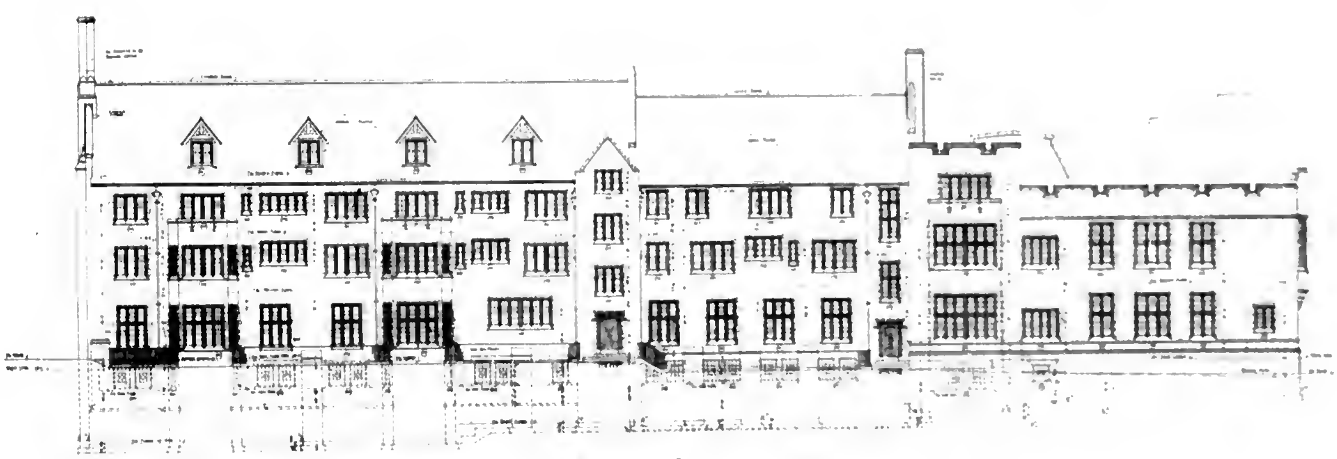
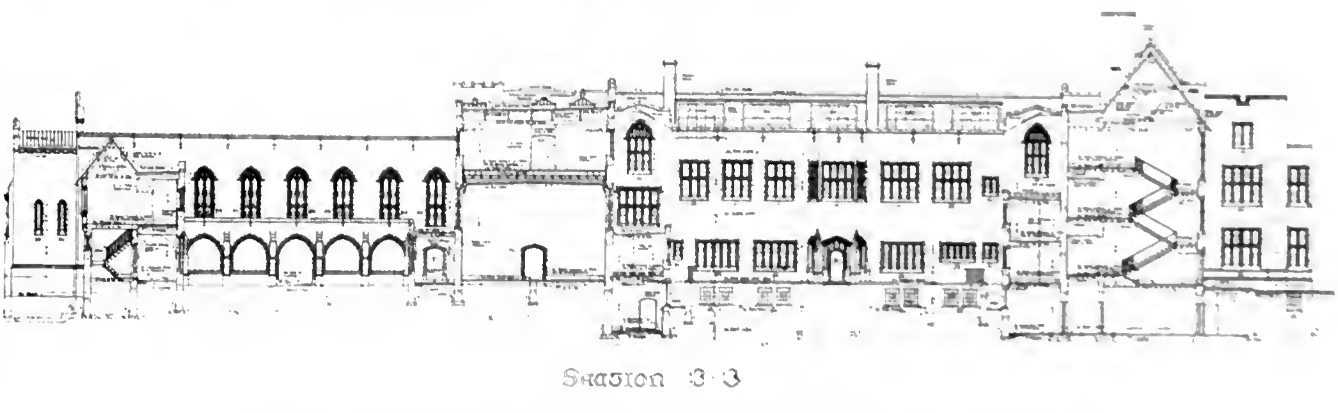


West · Elevation



Section 3·3

Sections and elevations Bishop Strachan School, Toronto

System Applied to Street Management

Applying a scientific, systematic business plan to street and road improvements, repairs and maintenance—Making it a business organization

By W. P. Blair*

STATE highway departments, collegiate institutions, and even the office of Public Roads of the United States, have deemed it advisable to construct various types of roads, and roads of like type, of somewhat different construction, with a view of study, recording data, watching behavior, keeping a correct cost, maintenance and repair charge, comparing wear and tear in an endeavor to reach some conclusion and gather some testimony as to the worth and value of such roads respectively. This endeavor on the part of these organizations is perhaps an effort as nearly practical as possible under existing circumstances. Still, in every effort of this sort one's conclusions are drawn but from one character of travel. It is necessarily alike over the various sections. No law of averages can be applied and the best results reached after years of study are of doubtful character. The conclusions are reached from conditions that are widely different from those actually existing on our streets as a whole, no one of which bears the same travel. The effort itself largely artificial, does suggest however, that no actual condition has been put to any practical purpose from which correct conclusions might be reached. And it does strongly suggest that the information sought is of great necessity.

Why cannot information of this character be obtained in a more practical and scientific manner and the information itself afford greater reliability and more adequately meet the necessities of the case.

There is no plan of street and road management or street administration that can be called fundamentally efficient for the reason that no plan management exists that includes in the construction, maintenance and repair, the availability of the information sought by the building of those so called experimental roads.

Streets which are improved are of various types.

They are in various states of repair.

They are of various locations.

Even a single street receives a variety of travel.

Single streets are often of such location that sections receive more or less travel.

The streets overlie varied conditions of soil.

Some streets must receive artificial drainage.

Influence of Promotors

The choice, the character, the type, the cost of all, are subject to a greater, or less extent to the whim, the notion, to the cheapness of cost, influence of zealous promoters, sometimes secured by one neighbor selling out another—in almost every case chosen from any consideration other than the ones upon which good sound judgment should be exercised. These streets representing one great mass of unknown conditions, evidence simply a lavish expenditure of money known to us as the streets of this city or that—roads of this county or that.

But few of these streets and roads have a legal name, most of them bear merely a nick name. None of them bear any identification whatever or relationship to commercial accounting such as is found in every well regulated commercial establishment. The original investment as to its part or its whole is not of record—is not charged; cost of up-keep is so confused with general charges against the whole lot that no knowledge whatever is obtainable as to the amount expended on any street or road, and we do not even know the actual reason for the expenditure, whether it was on account of repair due wear and tear, on account of some defect of original construction, on account of accident, on account of some cut and opening, nor does any record disclose whether the street or road has remained out of repair or whether repair was needed, or whether the street or road has cost in repair an amount exceeding any justification for maintaining a road wholly inadequate for the travel and traffic that passes over it.

This chaotic and inexcusable street and road mismanagement has been allowed existence because streets and roads are sustained by donation in some one form or another, their earning capacity is not held to account. In a commercial establishment, if a like manner and method of conducting was permitted, the institution would soon fall into bankruptcy. A department, a machine under such loose methods would continue in operation at a loss and escape detection. No information as to the value, the worth and economy of any tool or apparatus would be possible upon which improvements could be suggested and undertaken.

Street Management

What business plan is there, therefore, of street and road management that could be put into operation which would serve immediate and emergency needs equal to any plan now in existence, and at the same time furnish such accurate information as to original cost, cost of operation and services, usually designated as maintenance and repair, the application of such supervisory oversight as that when a break occurs it could at once be determined whether or not it was due to wear or tear or an original defect in some part. Dealing systematically with cuts and openings and replacements to effectually regulate to the greatest advantage of the street, that annoying privilege.

Separate these streets in certain divisions and those divisions into sections, of in no case exceeding one mile in length. These sections must be measured, numbered, and recorded for the purpose of complete identification. To illustrate: East 45th street, division number 9, section 17, beginning at the north property line of Superior and ending with the south line of St. Clair, including intersections therein, 4,800 feet in length.

You can then treat that particular section of street as a thing, a piece, as a machine from which you can extract information, of every kind and character. Similar information can be gathered in like manner from every street within the corporate limits of the city. With the information in hand, which is possible to gather under such a plan, the adaptation of streets of type and kind for the varied services, in a

*Presented before Section D of the American Association for the Advancement of Science at the Columbus meeting December 29, 1915.

short time will become apparent not only to the student applying a refined study to the situation, but to the layman as well.

Every county should be required by law to establish a complete identification of roads within the county by section number, of lengths not exceeding two miles, and location by township, and such identification should be made of record and in all cases of contract, maintenance and repair, expenditure therefor should be made and charged as against the particular section upon which the expenditure was made. By such a plan of road and street management, the greatest possible economy would at once become apparent by the ability to trace the actual dollar to the thing purchased for the particular road. Aside from this benefit, data, experience and comparison would become available for future judgment. Street and road improvements, maintenance and repair would at once become a scientific, systematic, business like operation and wasted millions would be saved.

High Level Bridge at Cleveland, Ohio

591 ft. three-hinged arch span holds third place in span length in America—Relatively simple and inexpensive erection devices used

Satisfactory progress was made in the erection of the new Detroit-Superior high-level bridge at Cleveland during the past season by the use of relatively simple and inexpensive erection devices. The 591-ft. three-hinged arch span, now completed, holds third place in span length in this country, being exceeded only by the Hell Gate arch and the Niagara arch. The steel for the arch span was erected between July 29 and Nov. 5, including the placing of the double-deck floor.

The closure of the main arch was made on October 8, using screw toggles in the back-stays for adjustment, in a manner similar to the closure operations for the Hell Gate arch, with telephone communication. The essential difference in the two operations was in the use of toggles for adjustment of the Cleveland structure and screw jacks upon the vertical posts of the backstays in the Hell Gate arch. Cantilever erection using backstays was the fundamental method in each case, but the Detroit-Superior arch erection was started at each end from a high tower on which the traveler was assembled, and the backstays could be carried to the next adjacent pier to develop the uplift.

Steel Erection Towers

At each end of the main arch span, just behind the abutment piers, a 90-ft. steel tower was first erected by means of a 115-ft. ginpole. This ginpole was used from the ground to erect the lower section of the tower, then raised to the level of the pier and supported on the tower section already erected, and finally raised another panel for the purpose of erecting the top-chord traveler and two stiffleg derricks.

On top of the erection tower, shown in one of the photographs, is a beam runway for the traveler frame, which cantilevers over the tower. The horizontal steel struts are part of the tower, as can be seen in the photograph. They transmit the component from the anchorage at the adjacent pier to the main pier, thus eliminating any horizontal thrust due to cantilever erection. The maximum stress in each backstay, including wind, was 2,230,000 lb., and the area was 143 sq. in. The backstay consists of a line of eyebars supported by the tower and containing the framed toggle arrangement clearly shown in one of the views.

The toggle was designed to put the adjusting screws in tension, and these screws were turned by a shaft connecting them, as shown, in order to insure uniform movement of both arches. The power for turning was obtained from a single-drum hoisting engine on the ground below, connected to a sheave wheel on the center of the shaft. One turn of the toggle screw at the beginning was computed to cause a vertical downward movement at the crown of the arch of $2\frac{3}{8}$ in., and thirteen turns of the shaft were re-

* Engineering Record

Fig. 1—Traveller on Steel Tower erecting end panel of Arch

Fig. 2—Toggle in back stay—Screw in Tension to Lower Arch

quired for one turn of the screw. The total stress in the eyebars at the toggle was 2,530,000 lb. including wind, and the maximum component carried by the screw was 517,000 lb. tension. The screw is 9¾ in. in diameter, with 1¾ in. pitch.

The top-chord traveler was a timber framework consisting essentially of 12 x 12-in. horizontal chords with 4 x 12-in. bracing, and two transverse struts of braced timbers. In order to allow for the changing slope of the top-chord runway and keep the lower sills of the derrick horizontal, adjustment was pro-

Fig. 3—Top chord Travellers lift steel from scows during erection of Cantilever.

vided by a line of holes in the two 15-in. channels to which the built-up shoe at the rear of the derrick was bolted. Two 25-ton stiffleg derricks were mounted on the frame, the transverse legs being spliced at their intersection.

Erection Progress and Closure

The erection of the steel arch was begun on the east side July 29, and on the west side August 26. The delay on the west side was due to awaiting the completion of the main pier, and the erection progress was fixed by the west cantilever. The travelers were supported on the steel I-beam stringers of the span, temporarily used on timber bents above the top chord for the first four panels, as seen in the photograph. In beginning the erection of the end panel, the end lower chord, which is the heaviest member in the bridge and weighs 30 tons, could not be handled by the derricks without special equipment. As connection of the backstay to the end of the chord could not be made until the panel was erected, falsework bents were used for the end panels. A pair of sheerlegs on the face of the pier, with tackle attachment, made it possible to use the derricks for hoisting the end chord.

The actual working time on the west side for erecting the arches and bracing was 32 days of 8 hr. each. In this time about 1,250 tons of steel was placed on the west half. All truss members up to the four center panels, except the bottom chords, were riveted up, the other joints being bolted until after closure.

Closure—Special Erection Struts

The closure of the arch was successfully accomplished October 8. The two halves of the arch lined up within ⅛ in., easily adjusted by a cable, and were within 22 in. of bearing when the lowering operation was begun about 10.30 a.m. By 2.23 in the afternoon, with a 2-hr. intermission, the arch closure was completed. Telephones were used at each hoisting engine turning the toggle screws, and at the centre where the superintendent of the erection company controlled the operation. A total vertical motion at the center of about 22½ in. brought the arch to a bearing.

Owing to the fact that the adjacent concrete arch spans cannot be placed until after the main steel arch span is erected and the backstays and towers are removed, the main abutment piers are subjected to excess unbalanced thrust until these arches are in place. To provide for this thrust two concrete struts 5 x 7 ft. in section were placed between the bases of the abutment pier and the adjacent pier where the next arch had been placed and was thus available for resistance.

Erection of Floor

The double-deck floor system, with six trolley tracks on the lower level and a highway floor and sidewalks on the upper level, was erected from the center toward the ends by the travelers on the top chords. As in the case of the main arches, the material was hoisted from scows in the river. It was placed by the following sequence of operations: First, the 8 x 1⅜-in. nickel-steel hangers were placed in the arch chord, then the pin-connected floorbeams of the upper level and the builtup hangers for the lower level were erected. The lower-level floorbeams were then placed and the riveted connections to the hangers made. Stringers and bracing could then be erected.

By November 5 all steel, about 4,200 tons, had been placed. Nickel steel was used for the main members and carbon steel for the bracing and floor system. The concrete arches of the approaches are all placed except the two adjacent to the main arch.

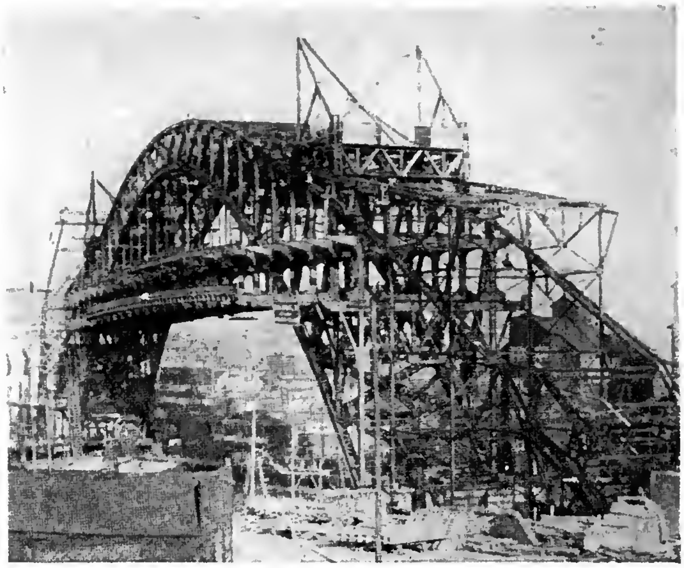


Fig. 4—Archclosed and double-deck floor steel placed by returning Travellers.

The west approach is now completed, and also the lower decks on many of the spans of the east approach.

The contractor for the fabrication and erection of the steel arch was the King Bridge Company, Harry Fuller, chief engineer, was in charge of the design and construction of the erection material.

Fuller Details in Specifications

The duty of the Engineer or Architect to supply adequate details of existing conditions—A complete list of quantities, with a schedule of unit prices

By Owen W. Smith, C.E., Mem. C.S.C.E.*

Much has been said, written and spoken about plans of structures, with all their accompanying detail, but little has been said or discussed about specifications, which all know go hand in hand with all plans, and in contract work is one of the written documents of the contract ranking next in importance to the plans. This paper will not attempt to describe in great detail what is necessary to make a specification complete and full on every point to be covered in various classes of work. The intention is rather to discuss and comment on the general principles of specifications as they have been handed down to us by our predecessors, in this line of endeavor, and as they are written and enforced in our own day.

Specifications solely for materials, or processes, and not prepared strictly for use in a contract do not present the same problems that arise when the specifications are part of a contract document.

Nor are they so important in certain types of contract such as the cost, plus a fixed sum, or cost plus a percentage contract, as changes in the class or style of work can be much more easily made without making the changes a point of dispute between the Engineer and the Contractor.

But in the ordinary class of straight contract, in which the parties are bound within definite and prescribed lines, too much care cannot be taken in drafting the specification which becomes a vital part of the contract.

Under the unsecured cost contract they are of more vital importance to success than under the secured cost contracts for the reason that when a man is paid the cost plus a profit for all work it matters little to him what he may be required to do or how he must do it; when, however, he is asked to name a sum of money for which he is willing to do certain work, he must know accurately what he will be required to do for the money, otherwise the sum he may name will be like a gambler's guess rather than an accurate estimate.

Primarily specifications are drafted so that in conjunction with plans certain works may be built, the objects in view being that the work will fulfil the duty for which it is designed, will be accomplished for a certain, sum, and will be completed within a certain time.

Duties of Specifications

The chief duties of the specification are these: to define or describe the work so that any competent contractor may submit an intelligent bid, and to establish a guide and a standard by which the contract may be interpreted with fairness to each party.

To attain the first of these desired results, great attention should be given to accurately and clearly describe what is desired to be done and the existing conditions under which it is to be constructed.

A complete specification, in conjunction with the plans should indicate clearly, concisely and accurately all the details of the structure; the class of materials to be used, what is to be supplied by the contractor, and by the corporation, and in the case of corporation supplies, where these are to be delivered. Also the local conditions, such as the conditions of the substrata on which foundations are to be placed, flood conditions, where they affect the work, should be fully described, and any other matter which might affect an intelligent bid one way or another.

It is not sufficient that the engineer should merely indicate by the plans and specifications the type and character of the structure to be built. Usually he has a great many advantages in planning an enterprise over those enjoyed by the contractor. Generally he is not limited in the time taken in drawing his plans and drafting his specifications, and has, or should have, ample time to investigate all conditions and make researches prior to the time when bids are called. No structure or work should be designed without a full knowledge of local conditions.

We often find, however, that the bidder is not given any information about local conditions, even when it is in the possession of the designer and he is left to shift for himself and get, as well as he can, the information which has a most important bearing on the ultimate cost of the work.

Time to Tender Often Short

The time allotted to the contractor is often too short to admit of anything but a brief survey of conditions, and he has to practically guess about conditions, which are of vital importance to all concerned. Hence we often find, as a result of lack of this information, a great range in the amounts bid, a wiser and sadder contractor, and a worried and disgusted engineer. Further, it is the duty of engineers or writers of specifications, to provide positive information of local conditions pertaining to the work, above ground and below.

Is it not sufficient to ask bidders to spend their time and money in obtaining that information which is solely within the province of the contractor, and supplying the required security, without putting them to the necessity of gathering data, which is within the province of the engineer to do so?

In this connection the point of view of many engineers appears to be that they confer a favor in handing plans and specifications to a contractor for bidding purposes. Money deposits are often required before these can be obtained and frequently they are not permitted to take them from the office, and requests to have them sent by mail are refused. It is hard to see how the contractor is under any obligation in an effort to bid on work, as these efforts will require both time and money to accomplish, and with every prospect, on the average, of the contractor being out of pocket.

Viewed from a business standpoint, competition is the life of trade, in these matters as in others, and the engineer's duty to his employers or client would be to facilitate in every way the interest of all prospective competent bidders.

Under this heading it will be proper to discuss briefly the actual wording of specifications before passing on to the next phase.

Clearness, brevity and consistency are the three

* Before Regina Branch C.S.C.E.

things to be attained in the wording of a specification. Lengthy sentences of necessity become involved, and reiteration of descriptions of similar works and materials does not add strength to the document. Tautology is to be avoided if possible. Words such as "proper" and "sufficient" being indefinite have little meaning, and the writer should avoid them by stating clearly what is proper and sufficient.

Stock clauses, or standard specifications to apply to different classes of work, or different works of the same class, are dangerous, and may lead to serious trouble between all parties concerned.

Clearness, Brevity and Consistency

To sum the matter up; if the specification drafter clearly understands what he is writing about, says exactly what he means, and not a word more, clearness, brevity and consistency will be attained.

Now in regard to the second requirement which has been laid down as a basis, namely, to establish a guide and a standard by which the contract may be interpreted with fairness to each party. Several things are essential to accomplish this, such as;—

(1) A complete list of quantities of all work.

(2) A schedule of unit prices of all items in the work. This of course would mean a unit price bid which can easily be figured to a lump sum if desired.

(3) And in addition a schedule of prices for extra work.

Bidders should not be required to estimate their own quantities. The bidder, while perfectly competent to construct the work, may not be expert in calculating quantities and, in the limited time usually at his disposal, should not be required to spend time on these details, which would be more profitably spent on matters essential to intelligent bidding, such as the labor problem, materials, insurance and the hundred and one things which must be foreseen in actual successful construction work. A definite list of quantities provides a basis of working which not only aids the bidder in estimating closely, but gives him confidence in the engineers who are to direct the work, and frees him from that haunting suspicion that perhaps in haste he has omitted something; or else he may estimate too largely making his bid appear absurdly high.

A schedule of unit prices for extra work which might be encountered will eliminate, in a large measure, force account work and such items which often become a bone of contention between contractor and engineer.

(4) All items in the schedule of prices should be adequately covered by a corresponding clause or section on the specification.

The difficulty of obtaining fully detailed information of what is really wanted when bidding on work is one of the serious problems which often confront the contractor, for it is largely the details which determine what work is really worth.

The more doubtful therefore the bidder is as to what may be required of him, the greater sum he will add to his price for contingencies which may arise. This will be particularly so if the engineer bears a reputation for narrow-mindedness and arrogance.

The gist of the matter up to this point is to give all the necessary information in a specification, whether it be description of work and material, local conditions, quantities, matters of extra work, etc., and to have it properly expressed so that all bidders may precisely and explicitly know what is required of them.

Penalty Clause

It is well known that time penalty clauses are not often enforced in a contract, and the general opinion largely prevails among construction men that they are of little effect. One of the chief reasons for these conditions is that usually the owner, corporation or engineer is unable to keep their part of the contract exactly on time, and there is always an avenue of escape opened for the contractor.

It is conceivable that in some construction work there is an absolute need of it being finished by a certain time, and in such cases the penalty clause may have some legitimate use, but in the usual construction contract its principal effect would be to raise the amount bid by tenderers who have fears of its application.

It can be laid down as a rule that the competent contractor is most anxious to finish the job as rapidly as is consistent with efficiency. Construction work in common with many other operations has an efficient and economical rate of progress. To exceed this means increased cost and therefore, if possible, specifications should state a reasonable time for the completion of the contract, giving due consideration to unforeseen difficulties and contingencies which may be encountered in the work, and also in the customary local conditions appertaining to the work.

The time penalty clause should be used only in exceptional cases where it is an absolute necessity to complete within a certain time. The careful bidder will then make due provision for the same in his tender. It seems ridiculous to have, for example, a fifty dollar per day, time penalty clause placed indiscriminately in all contract specifications, when in nearly all cases the contract will be carried out along the usual lines of making speed as rapidly as circumstances permit.

Business Relations

Specifications are usually divided into two divisions, the first, with which the foregoing remarks have been dealing, viz. the clauses relating to the description of the work whose accomplishment is the object of the contract, called "Specific Clauses".

The second division relating to the rights, duties and obligations of the contracting parties, and the engineer or owner. These might be called the business relations. In this country they are generally classified as "General Clauses".

During the process of developing specifications it would appear that the general clauses have received more cultivation than the specific clauses.

Many of these latter clauses (sometimes known as "The Big Stick" clauses) are manifestly unfair, illegal and injurious to the engineering profession.

Inspector's Powers

The clauses governing the inspector's power are also usually contradictory, for example: An inspector shall be appointed by the corporation and the contractor obey without question his order and instructions, but no approval of the inspector shall be taken as an acceptance of improper work or material which must in every case be removed and promptly replaced when discovered.

The inspector has power to order defective work or materials but has no power to accept same. Surely an unfair condition to impose.

(Concluded on page 61)

The Disposal of Sewage by Dilution

A bio-chemical method of purification—Effect of normal sewage on streams—Much depends on the amount of oxygen dissolved in water (concluded)

By W. E. Adeney, D.Sc., F.I.C.

In order fully to appreciate the very serious injury which sewage or other refuse solid organic materials are capable of causing in a stream, it is necessary to understand the wide difference of their behaviour towards the dissolved oxygen of any water through which they become dispersed when (1) in the fresh condition, and (2) after undergoing bacterial fermentation under anaerobic conditions when deposited for any length of time along the bed or banks of a stream.

Sewage or refuse solids in the fresh condition, like fresh sewage liquor, when dispersed through large volumes of "clean" water, do not directly combine with the dissolved oxygen, but are only induced to do so indirectly and gradually under the influence of any water bacteria that may feed upon them.

When, however, the same solids, after remaining deposited on the bed of the stream for any length of time, and undergoing anaerobic fermentation, become dispersed through "clean" water, the sulphides and deoxygenated organic bodies now mixed with them will directly combine with the dissolved oxygen immediately they come in contact with it. So that, while the waters of a "clean" stream may transport sewage or other refuse organic solids in the fresh condition, and may carry them for several hours without suffering any appreciable reduction in their dissolved oxygen content, the same solids, after remaining deposited along the bed and banks of a stream, and there undergoing anaerobic fermentation, will, when disturbed and dispersed through a like body of "clean" water, immediately absorb the dissolved oxygen of the water by direct chemical combination with it.

Injury to Rivers

Many of our rivers in this country suffer more or less serious injury from sewage solids in the manner here described. The writer has had opportunities of carefully investigating the condition and circumstances of several of such rivers, and he has given detailed description of some typical examples in the Appendix VI. to the Fifth Report of the Sewage Commission. Reference may also be made in this connection to the 1912 report of the Metropolitan Sewerage Commission of New York, and also to the 1914 report of the same commission.

It will suffice to give here, by way of illustration, one typical example: The Yorkshire river Ouse for a great part of its course is a fairly clean, natural stream. In spite of some rather considerable pollution by the sewage of towns and villages, there is nothing in its waters to prevent or destroy fish life. But near Goole, where it is joined by the Aire and Don, it becomes at times seriously polluted by putrescent sewage solids brought down to it by these tributaries during freshets. It is a matter of yearly complaint that the gross pollution of the upper reaches of these streams occasionally poison and deoxygenate the waters of the Ouse, and prevents the passage of salmon trying to ascend it from the Humber.

Both the Aire and the Don, between their most polluted reaches and their junctions with the Ouse, flow through courses of considerable length, and along which they receive little further pollution, and in which the bio-chemical oxidation of liquid sewage organic matters that had become mixed with their waters is very considerably advanced.

But both tributaries, it must be remembered, are very grossly polluted along their higher reaches. Thus the Aire, with its nearly equal effluent the Calder, drain an area within which lie the towns of Bradford, Leeds, Huddersfield and Wakefield, and villages in which the woollen trade of the West Riding of Yorkshire is carried on.

During dry weather crude sewage solids are deposited along the beds and banks of the upper reaches of these rivers, but the liquid portions gradually undergo fermentation as they are borne along by the waters of the rivers, and the writer has found that, by the time they reach the Ouse in dry weather, practically the whole of the dissolved sewage organic substances originally present becomes completely fermented, and that the second stage of fermentation—that is, the bio-chemical oxidation of the ammonium compounds, has been well established.

But during freshets the sewage solids which had accumulated in dry weather in these rivers, and had meanwhile become putrescent, are washed down into the Ouse, and absorb the dissolved oxygen of its waters, so that the waters are rendered incapable of supporting salmon and other fish life.

These solids also become deposited along the banks of this part of the Ouse and temporarily discolor it. The banks of the river are steep and uncovered at low water. They are overlaid with clay and fine sand, which, as just stated, becomes discolored after freshets, but appears of a clean yellow color during dry weather. A good deal of this solid polluting matter, however, remains imbedded in the clay below its surface, and causes further injury to the waters of the river, as will appear from the descriptions that follow.

The Ouse and its tributaries the Aire and the Don are influenced by tides for considerable distances above Goole. The rate of flow and ebb in this portion of the river Ouse varies very greatly during spring and flood tides. At spring tides the flood lasts about 2 1-4 hours, with an ebb of 9 1-4 hours, and a period of quiescence of about half an hour at high and low water. At neap tides the flood lasts for four hours, and the ebb for 7 1-2 hours.

At spring tides the river Goole rises from 16 ft. to 20 ft., while at neap tides the rise varies between 10 ft and 13 ft.

The great and rapid rise of the river during spring tides must obviously produce a strong scouring action on the banks of the river, and a much stronger action than at neap tides, when the river rises more slowly and to a less height.

Tidal Investigations

Dr. Maclean Wilson has published some valuable and instructive results of some careful investigations that he has made on this portion of the river Ouse during spring and neap tides, and his chemical analyses show that the suspended matters carried by the waters of the river is very much greater during spring tides than during neap tides—the maximum range being 1,100 parts suspended matter at spring tides to 75 parts per 100,000 parts of water during neap tides.

Notwithstanding the fact that the liquid sewage matter in the river is diluted with very much larger volumes of clean water at spring tides than at neap tides, the dissolved oxygen content of the river waters during spring tides is nevertheless considerably less than at neap tides. The only possible explanation for this apparently anomalous state of things is that the clay and sand which are disturbed by the tidal currents in this portion of the river contain putrescent sewage solid matters, and that these matters are more effectually scoured and dispersed in larger quantities through the tidal waters by the spring tidal currents than by the neap tidal currents, and that these putrefactive matters rapidly absorb dissolved oxygen from the tidal waters as they become dispersed through them.

As regards the possibility of liquid sewage matters contributing to an appreciable extent to the exceptional deficiency in the dissolved oxygen content of the spring tide waters of the river, several reasons may be advanced to show that this is impossible. For example, Dr. Maclean Wilson's analytical figures show that the proportions of liquid sewage matters in the spring tide samples are about ten times less than those in the neap tide samples, and that, nevertheless, they show a greater deficiency in dissolved oxygen. Some of the spring tide samples were so slightly polluted by liquid sewage matter that they contained no ammonia, and yet, notwithstanding this, their dissolved oxygen content had been so greatly reduced that they were no longer able to support salmon and other fish life; while the neap tide samples, though they contained very decided quantities of ammonia, indicating distinct pollution with liquid sewage matter, their oxygen content was not so largely reduced. It was, in fact, usually above the minimum required by salmon and other fish life.

Sufficient has perhaps been stated in the foregoing pages to indicate the great danger of discharging sewage solids into streams, the currents and physical circumstances of which are not such as to ensure the satisfactory disposal of such sewage matter.

Sewage Solids

In every such case the sewage solids should be removed before discharging sewage liquor into the stream.

Streams are to be met with, however, which are capable of satisfactorily disposing of the solids as well as the liquor of crude sewage matter; and it becomes interesting and instructive to consider what may become of the solid matters when discharged into such streams. But little attention has hitherto been paid to this question by engineers and chemists. A good deal of information has, however, been obtained concerning it from recent investigations by water biologists.

In the case of such streams the volume and flow of their waters are sufficiently great to prevent the permanent deposit of the sewage solids discharged into them at any particular point, and to distribute them widely through large volumes of water or over wide areas of clean bed. Under these conditions neither the waters nor the bed of the stream can become fouled, and the former will remain well stored with dissolved oxygen. Other forms of organisms besides bacteria will then flourish, and will feed upon the organic solids thus widely distributed through the waters, or over the bed of the stream.

Microscopic Organisms

Some of these organisms possess the mode of nutrition characteristic of animal forms of life, and do not consequently exercise by their vital processes the drain upon the supply of dissolved oxygen in waters by causing an oxidation of food materials in the way that bacteria do. They consequently do not require so much oxygen for like quantities of organic matter consumed. They can, moreover, it is well to bear in mind, only continue to thrive in well oxygenated water. They are to be found among the forms attached to the bed of the stream—e.g., annulosa, mollusca and large crustacea; among the micro-organisms, which, by reason of the minuteness of their size and feeble powers of locomotion, are carried about passively by the waters of the stream, and include animal organisms,invisible or barely visible to the naked eye, as well as the two great classes of saprophytic and nitrifying bacteria already considered; and, finally, among the various forms of animals—e.g., fish (pisces)—which freely roam through wide areas of water.

The above three categories of organisms occur more or less abundantly in clean river and inshore tidal waters that are exposed to a pollution slight in extent relatively to their volume and flow from agricultural or domestic drainage, and all may assist in the work of the destruction of the solid organic refuse matters in such waters.

The microscopic organisms of fresh and salt waters—termed collectively the "plankton"—have been shown to play a very important part in the consumption of solid refuse matters in waters. These minute organisms are nourished by a true animal mode of nutrition—that is to say, they absorb solid particles of organic foodstuff at any point on their surface—as in the case of the simplest protozoa, digestion taking place within the cell; or, as in the case of organisms higher in the scale of life, they possess a distinct oral aperture, through which the solid particles enter, and an anal aperture, through which undigested portions of food are expelled.

Besides the protozoa, minute crustacea abound in the "plankton" of waters, and of these the most important in sea water are the copepoda. These organisms lead a predatory life, and well deserve the name of scavengers. They feed largely on sewage, and convert sewage into good food for fish. The rotifera also plentifully occur among the "plankton" of fresh water.

Thus, in the "plankton" of a water organisms exist which in their several ways and by their joint action are capable of completely consuming any sewage matters, liquid or solid, that may be associated with them, always provided that the waters shall at all times be well supplied with dissolved oxygen throughout their mass.

That minute organisms possessing a true animal mode of nutrition can consume the solid organic matters of crude sewage at an extraordinarily rapid rate under sufficiently favorable conditions has been proved by the experiments recently carried out in America by Messrs. Edward Barlow and F. W. Mohlan on the "Purification of Sewage by Aeration in the Presence of Activated Sludge" (Journal of Industrial and Engineering Chemistry, p. 318, Vol. 7, 1915). In these experiments crude sewage was nitrified in five hours, and the biological examination of the purified sludge from these experiments showed that among the microscopic animals found were many vorticella and rotifera, but that the predominant organism is a minute worm—Aeolosoma hemprichi. This organism abounds in various kinds of fresh-water streams where there is an abundance of decaying organic material, and thrives especially well where there is much fermentation in waters contaminated with sewage, provided that there is an abundance of oxygen. It belongs to a group of worms in which reproduction occurs very rapidly by asexual methods. It must be noted, however, that, although the purified sludge from the experiments was free from unpleasant odor, and continued to be so, so long as these and other organisms, of which it largely consisted, remained alive or in a fresh condition, it nevertheless became offensive when these organisms died and suffered putrefaction. These experiments afford, therefore, a good illustration of the superiority of water bacteria as scavengers over organisms that are nourished by a true animal mode of nutrition so far as end products are concerned.

Sewage Matters in Streams

But it may be urged that, even when sewage matters are discharged into streams under the most favorable conditions for their satisfactory purification, their destruction as such by living organisms will not be effected immediately, but only after extended periods of time. So that, if any poisonous bodies be associated with the sewage matters, the waters of the stream may remain poisoned for a considerable portion of their subsequent flow.

This aspect of the sewage dilution problem has also been very carefully investigated of recent years, especially by Dr. Houston, for the Sewage Commission and for the Metropolitan Water Board, and his very elaborate and prolonged investigations have clearly shown that the dangers of a properly controlled and limited pollution of a stream by sewage matters are not necessarily as great as has been hitherto supposed. He has shown, on the contrary, that the view hitherto held that a polluted river water, such as the Thames, may be at all times dangerously infected by disease germs is not founded on fact; but that the real danger to guard a river water against, in the interests of public health, is the accidental intrusion of specifically infected excretion from disease carriers.

This conclusion, it may be incidentally pointed out, is entirely supported by the immunity from specific diseases of communities dwelling or working alongside of tidal and non-tidal waters that are polluted often to a considerable extent with sewage matters, and in the habit of making use of such waters for boating and other purposes, including domestic use, except that of drinking.

Antiseptics and certain trade waste liquors would certainly exercise a poisonous influence in a stream if directly discharged into it in the raw condition, or if allowed to drain in too large proportions into a sewer; and where necessary such waste must be specially treated before being discharged into a stream.

But it is the common experience in sewage purification works of towns in which bacterial processes are carried on—e.g., percolating and contact beds filtration processes—that they are not present in sufficient quantity to interfere with the purification of the sewage matter. No doubt they gain access to sewers, but by the time the sewage reaches the purification or outfall works they have either been destroyed or have been so largely diluted as to be rendered harmless to living organisms.

Although the experimental investigations and views referred to in the foregoing pages all go to free slightly polluted river waters from the odium attaching to them as being necessarily sure sources of disease-producing bacteria, the writer wishes emphatically to support the view that, when any river water is drawn upon for a potable water supply to a community, every possible means should be adopted for guarding against the danger of accidental infection, and for ensuring a sufficient chemical purity of the water for all the purposes incidental to the varied requirements of such community.

This discussion of the dilution method of sewage purification may perhaps be fittingly concluded with the following definition of the term "normal" sewage: "Normal" sewage matters are refuse matters, the fermentable organic constituents—both in solution and in suspension—of which can be purified, without previous treatment of any kind, by living organisms.

Fuller Details in Specifications

Continued from page 59

To the credit of engineers be it said that disputes are usually settled on a basis of justice and equity to all parties. Nevertheless much injustice has been done by narrow minded and arrogant individuals who have taken advantage of the literal reading of these clauses. Particularly where the amounts involved are not great. Business men well know that it does not pay to enter into litigation unless the issues at stake are important, because the large corporation or municipality have plenty of money and legal machinery to give battle to the contractor, without any individual suffering personal loss.

These things, however, do not reflect credit upon the ability or character of engineers as a class. Hence we see many contractors voicing a profound contempt for the engineering profession. This is of great disadvantage to the profession at large, and also to the interests of the general public. Engineers, as servants of the public in the highest sense of the term, should maintain a high standard of fairness and justice, as in so doing, they best conserve the interests of their employers. Nothing is to be gained in the long run by endeavoring to get something for nothing from a contractor.

Contractors are as susceptible as a weather vane to the personality of an engineer, and the unfair or unjust individual's reputation will follow him, and will be sure to increase the cost of his work, or, in other words, the cost to the public.

No one will object to the proper safeguarding of the interests of the owner or public, but this can best be done by a fair bargain in which each party knows thoroughly what is required, and each make themselves responsible for their own particular part of the contract, agreeing on a fair method for adjusting unforeseen contingencies which are usually bound to occur.

The Customs receipts of the city of Toronto for the month of December amounted to $2,128,-050—the largest in the history of the city.

Construction Features of Mexico Plant

Described by Mr. R. F. Hayward before Vancouver branch of C.S.C.E.—Fortunately little interfered with by revolutionists

Nearly all of the prominent men connected with the formation and development of the Mexican Light & Power Company's enterprise have passed away in the last few years. Don Porfirio Diaz, President of Mexico, by whose government the enterprise was made possible, died last year. Sir George Drummond, Sir Edward Clouston and James Ross, directors from the inception of the undertaking, and J. D. Schuyler, consulting engineer for the Necaxa Dam, have also passed away. And now but a few months ago Dr. F. S. Pearson, the engineer to whose fertile brain and energy was due the conception, planning and completion of the undertaking, went down with the Lusitania. It therefore seems a fitting time to call to mind some of the features of the Necaxa development, which, for variety of new problems and difficulties met and worked out, is still quite unique in the history of water power development.

Mexico City is situated on a plateau nearly 8,000 feet above sea level, surrounded by a rim of mountains rising from an elevation of from 10,000 to 17,000 feet and including three extinct volcanoes, Popocatepl, Ixtaccihaatl, and The Peak of Orizaba.

A traveller journeying 100 miles in a northeasterly direction from the City of Mexico comes to the rim of a plateau and finds himself suddenly entering a wild mountain region as if from the clouds. These are the slopes from the plateau to the Gulf of Mexico, along which the warm moist air from the gulf, condensed by the cold drift from the plateau above, produces a rainfall which amounts to as much as 150 inches in a year, giving a run-off which, though it varies greatly from month to month, is sufficient to produce large quantities of power from comparatively small watersheds.

The valley of the Necaxa is formed by two limestone ridges and has been filled by successive flows of lava, to a depth of some 1,500 feet. Between the limestone mountains and the lava on each side of this valley the water has cut a channel forming the Necaxa River on the one hand, and its tributary, the Tenango, on the other. At a point some twelve miles below the rim of the plateau this river has cut out a gorge in the basalt 1500 feet deep, and arrives at the bottom in two vertical leaps called Salto Chico and Salto Grande, the upper fall being 360 feet, while the lower one is 740 feet.

The problem presented to Dr. Pearson was to utilize the power of the river going to waste over these falls and to bring machinery for the plant and all that was required for construction into a wild mountain country, where the sole means of communication was a mule trail, and the nearest railway was thirty miles away.

A three-foot gauge railway, thirty miles long, had first to be constructed, and this, owing to the nature of the country, had to be built with curves of the smallest radius possible for Shay locomotives, and with grades as high as 8 per cent.

In order to make use of the mean annual run-off of the watershed of the Necaxa River, four reservoirs were constructed, and later, when it was found necessary to develop more power to meet the rapidly increasing demand, two other reservoirs were built while a series of tunnels, one of which was two miles long, were built to tap adjacent watersheds.

The construction of these reservoirs involved the building of seven earth dams all of them important structures as compared with other earth dams, and two of them, at least, higher than any earth dam that had previously been built. Some of these dams were built entirely by the hydraulic fill method; the others were a combination of core wall, rock fill, clay and earth fill, placed by hand labor, mules and steam shovels, with some hydraulic fill in the centre.

A description of all of these would be beyond the scope of this article, and there is space to refer only to the largest, or the Necaxa Dam. This dam was built entirely by the hydraulic fill method. It was 200 feet high from the bottom of the core trench to the crest of the dam, about 1,200 feet along the crest, and over 1,000 feet on the base from upstream toe to down-stream toe. The slope of the upstream face was three to one, and the down-stream face two to one. The lower toe was a heavy rock fill faced with three feet of rubble masonry laid in cement. The upstream face consisted of the lighter rock fill rip-rapped with stone, and the centre was fine sluiced clay. The total quantities in the dam were about 2,000,000 cubic yards, and in the preparation of the foundations 200,000 cubic yards

First Necaxa Falls, showing temporary plant.

Second Necaxa Falls, 740 ft. high.

Power House and Construction Camp.

of top surface had to be removed. There were three core trenches, one of which was 43 feet deep, and these were built with concrete core walls brought up to a considerable height above the foundation of the dam. All the material was hydraulically filled, and for this purpose a canal twelve miles long was built along the mountain side, bringing a

Necaxa dam from upstream toe showing sluicing trestles.

flow of 35 cubic feet per second under a head of 450 feet, which was used in 6-inch monitors for bringing down the clay and rock.

The material was carried to the dam in wooden V-shaped flumes placed on trestles, which were built up as the work progressed. The material was discharged along the edges of the upstream and the downstream slopes, the rocks and heavier material remaining where they were discharged, and the lighter silts and clays being deposited in the pond in the centre. By this means rocks as big as a man's body were carried through the flumes and deposited in the toes of the dam.

This was the first really large hydraulic fill dam that had ever been built, and as in so many engineering enterprises, when very large undertakings are carried out upon the experience of much smaller works, it was found that the methods previously used had to be materially modified.

While there was a heavy mass of rock fill on the lower toe, the rock fill on the upper toe was comparatively light,

Relief valves of 6-8000 h.p. wheels discharging under head of 1500 ft.

and the fine clay that had settled in the centre not only filled a bigger space than had been originally intended, but it never solidified, and consequently, shortly before the dam had reached its maximum height, the hydraulic pressure due to the head of semi-liquid clay became greater than the light rock toe on the upstream side could stand, and 500,000 cubic yards of material slid out of the dam early one morning. The work was repaired by sluicing a large quantity of rock into the up-stream toe, increasing the rock fill on the lower toe, and then finally filling the greatly reduced space in the centre with sluiced material. The dam, which has been completed for over three years, is absolutely tight and in every way satisfactory.

From a concrete intake tower, built on the upstream toe of the dam, two 6-foot steel pipes about three-quarters of a mile long conveyed the water to the top of the falls. From this point two inclined tunnels each half a mile long, were built on a slope of about 40 degrees, and inside each of these tunnels was laid, on concrete saddles, three 30-inch welded steel pipes. These pipes, which had to stand a head of 1,500 feet, or over 600 lbs., pressure at the lower end, were flanged and welded, and the joints were made by bolting each length of pipe together with loose flanges and a special rubber gasket. The pipes were laid and started practically without a leak, and have been in satisfactory operation ever since. Later, when an extension of the

Necaxa dam, lower rockfilled toe with masonry face.

power house was decided on, a third 8-foot pipe was laid from the dam to the head of the tunnels, and a third inclined tunnel, with two additional pipes, was built.

The power house was located close to the foot of the lower falls. The only access to the site of the power house was by means of a tortuous mule trail down the precipitous sides of the gorge. All the materials for the power house were brought down by means of two 15-ton Lidgerwood inclined cableways, stretched from the top to the bottom of each of the two falls. With these two ways the greatest weight of materials and machinery that could be carried down in a day was about 50 tons, consequently the work of construction of the power house and erection of the machinery was necessarily slow.

The power house consists of a massive concrete steel frame building, in which are installed six 8,000 h. p. waterwheels, driving 5,000 kw. generators, together with an equipment of switchboards and transformers for transmitting the power at 60,000 volts. The wheels are of the impulse type on a vertical axis, so arranged that the high pressure water and the whole of the water wheel is entirely below the generator floor, and are provided with relief valves so that the pressure pipes could discharge in a horizontal direction over the tail race of the power house whenever the pressure exceeded a certain predetermined amount. One of the accompanying photographs shows six of these relief valves discharging at one time under a pressure of 600 lbs.

When it became necessary to enlarge the power house these six water wheels were increased in capacity by enlarging the nozzles, as there was sufficient margin in the

(Continued on page 80)

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

Parliament in any country is alleged to be the boiled down and strained out essence of the people who elect its members. In short, a parliament is a country condensed. But is this true of Canada? This fair Dominion is as much a nation of farmers and manufacturers as the Motherland ever was a "nation of shopkeepers." But if we were to magnify our parliament and produce a country you would have a nation of lawyers and professional politicians with just an occasional farmer or manufacturer stuck in here and there. It would be a nation that would starve to death in the course of a month. Canada's parliament is, therefore, not truly representative of Canada's people—and the blame must rest at the doors of the intelligent electorate.

* * *

But after all, the electorate is not without excuse. When it comes to the polls to cast its vote it is generally offered a choice between a lawyer and a politician. So it does not make a choice. It simply closes its eyes and votes Grit or Tory even as its father voted before it. The successful farmer is busy tilling his farm; the successful manufacturer is busy making a success of his business and the country is left to the politician. The pursuit of money is the root of all evil—and our method of government is one of the resultant evils.

* * *

Politics in this country is a profession by itself. The members of that profession have a political economy all their own. Their ways are not the ways of the Canadian farmer or of the Canadian manufacturer. When one of the latter gets into "the House" he finds himself like the good Samaritan who has—wandered into a strange land. He is allowed to sit in the back benches and watch the wheels go round. In time he either adopts the ways of the politicians or flocks by himself and dies a political death superinduced by loneliness. He must needs vote with his party, condone the faults of that party and sing its praises, else his patronage is cut off and the machine back home either refuses him renomination or damns him with faint support after he is re-nominated. His political life is neither a long nor a merry one. Neither does he become an honorary colonel nor receive recognition at the hands of his sovereign. If you search our long lists of new-born aristocracy can you find a single name placed there because its owner denounced wrong-doing in his own party or stood for the rights of the people against the machinations of the political machine?

* * *

Do you wonder then that truly representative Canadians prefer the paths of private prosperity? Would you ask them to spend the years of their life they are entitled to enjoy trying to fight a system that has become a part, nay practically the whole, of our public life? Do you wonder that we have a Minister of Public Works whose crowning virtue is that he can win elections; a Minister of Trade and Commerce whose one asset is a caustic tongue; a Minister of Militia who can manufacture honorary colonels and grow cub officers that they may live at the expense of the country? It is also much of the reason why each party in turn goes into opposition and waits there till the aroma of certain scandals is carried away by kindly zephyrs.

* * *

American papers are throwing a lot of compliments across the line. The Detroit Free Press, for instance, rises to remark:

"Canada has called for 500,000 troops. Canada is showing England a real example of rising to an emergency."

But Canada has yet a long way to go ere she sticks out her chest and turns her back to be patted by her neighbors. She has given back to Britain the man material from across the seas that has not taken kindly to the tilling of her vacant acres. She has also given of her unemployed and her venturesome. Patriotic they are and brave. They have placed the name of our native land side by side with the bravest nations in the world. They have made the Germans extend the Hymn of Hate to all the far-flung Dominions of the Empire on which the sun never sets. Yet they were sons of a fighting race and they girded up their loins and went forth to battle with a fierce joy in their hearts.

* * *

The real test of sacrifice is now at hand. It comes not in the call for half a million men, but in the answering of that call. It comes when men who love not war but peace, not the blare of trumpets but the quiet fireside, are asked to prove that they love their country more than all else they hold dear in life. It comes when men are asked to give up good positions with the ease and comfort that accompany them, to serve as privates in the ranks—to face hardship and death, not for glory or love of excitement, but as their duty to that Empire that has guaranteed them liberty and the pursuit of a certain amount of happiness.

* * *

Nor has our business community yet learned the real meaning of rising to the occasion. Some lines of trade have been impaired by the war, but on the whole Canada is enjoying a very reasonable prosperity. We have given, some of us, not over liberally to the Red Cross Fund and the Patriotic Fund. We have been pestered by tag days and appeals. But I venture to say that not one of us has been compelled to deprive himself to any serious extent in the giving, while most of us enjoy our usual comforts and luxuries in the same old way. It is no hardship to have to give half a loaf while the baker shop around the corner is still doing business and your bank account shows a goodly balance. It is when you have only one loaf and there is no more in sight that the giving hurts. That time may never come. And if it never does Canada will never have an opportunity to show she can rise to an emergency.

* * *

So far the only actual suffering from a Canadian standpoint has fallen to the lot of the men who have gone to the front, and more particularly their womenfolk who have remained behind. Those who volunteer to fight will continue to be the sufferers, and those who are culling them out should see that none of their sufferings are contributed by their own government. It may be wrong to comment on the "cub" officers who strut about in khaki. Some are doubtless brave boys who will do their bit fearlessly and well. But they are unlearned in the ways of men and liable to be filled with their own importance. Can you, a man of almost middle age, imagine any greater torture than to be lorded over by a boy of eighteen who is earning his first money, not because he is fit to lead men into the valley of death, but because his father had sufficient political pull to secure his appointment? You can't. Well, that is what is happening in scores of places in Canada. Canadians know it and men refrain from enlisting, not because they fear the German shells or gases, but because they might be stood up against the wall and shot for boxing the ears of these same officers. Only the other day I heard a husky private remark: "The first six months after peace is concluded will be the busiest time of the war. We'll have so many officers to lick." It is cheery to report, however, that some of the officers now recruiting units refuse to accept any of the cub variety of officers. They are demanding full-grown men.

* * *

By the way, it looks from here as if Mr. Acton made an awful mess of that Hopkins clothing charge. He made his charge as bold as any lion and then when he got in front of Sir Charles Davidson he wanted to apologize so hard that he hired a lawyer to help him do it. He was evidently so unused to court procedure that he became nervous and engaged a lawyer even more nervous than himself. It never occurred to either of them to ask to have Hopkins' Toronto partner called for examination. To be sure he is a silent partner, but who knows but that the commission might have induced him to break his silence. There was Hopkins' bank account. Might that not have thrown some light on what happened to Hopkins in connection with one or more contracts that seem to have got tangled up with his real estate business. It might have shown where the money came from that is keeping Mr. Hopkins in New York. Or, if Mr. Hopkins' silent partner had been called might he not have been able to explain just why Mr. Hopkins had at this somewhat inconvenient season ceased to bother about clothing contracts and taken such an extended vacation. Mr. Acton either went too far or not far enough. He should never have put his charge in print unless he intended to fight it all the way through. The sudden fright he developed reflects credit neither on himself nor on the trade press.

* * *

For, you know, even if the Purchasing Committee never gave a contract to a real estate man, there is ample evidence that the Shell Committee was not too proud to give a shell-box contract to a shipping clerk or to a general storekeeper. The latter instance occurred down in Victoria County—at Fenelon Falls, to be more exact. The man who got the contract was C. W. Burgoyne, who with his father, forms the firm of W. Burgoyne and Company, which carries on a general store business. Now you can't very well make shell-boxes in a general store, you know, so Mr. Burgoyne looked around for somebody to do the work, and finally sublet to Alfred Tiers, who conducts a small planing mill in Fenelon Falls. The latter couldn't do all the work but by purchasing parts from a third party he was able to complete the contract.

* * *

Before its completion Mr. Burgoyne secured a second contract for an additional 25,000 boxes. This one was handled more scientifically, as Burgoyne and Tiers formed a partnership which did the work under the name of C. W. Burgoyne & Co. Now if the government was anxious to prove that the Purchasing Committee did not let a clothing contract to a real estate dealer shouldn't it be just as anxious to disprove that the Shell Committee let a shell-box contract to a general storekeeper? Isn't it really more necessary that the shell-box matters be cleared up because the Shell Committee was a creature of the Canadian Government handling money in trust for the Imperial Government? The Dominion Government has a sort of right to do as it pleases with its own money, but it owes it to Canada and to the British taxpayer as well, to show that every cent of Imperial funds placed with the Shell Committee was placed properly and to the best advantage. It is up to the Dominion Government to show that the shell-box contract let to a general storekeeper in Victoria County was not placed to relieve either political or "commercial depression brought on by the war."

There has been so much Bertram in this column that some of his friends accuse me of harboring a grudge against the doughty knight. But far be this from the fact. I regret to report that previous to the appointment of the Shell Committee I did not know there was such a person as Sir Alexander on this fertile continent. But you will readily admit there has been much Bertram in the Shell Committee. According to his own modest statement he was simply all of it. He let the contracts and saved the money. Others had been appointed by the Government to assist him in this great work, but he wanted it well done, so he did it himself. Others might be swayed by personal preferences or outside influences. Of himself only was he sure. He burned the midnight oil and wore himself out in health that the Empire might live. We know he did, for he has told us so himself. Consequently, when you discuss the Shell Committee you must discuss Sir Alexander Bertram. All we ever asked for him was fair play—a full and free investigation that would show the grand work he has done for the Empire to which we belong and for Sir Sam Hughes, possibly the greatest of its citizens.

* * *

The Ottawa Journal would now have us believe that the British Government appointed the Shell Committee. Nobody appears to want to own that poor deceased body save and except Sir Alexander Bertram. Wonder if he will wind up by accepting responsibility for its appointment as well as for each and all of its acts.

* * *

One shell manufacturer is credited with the statement that at the end of the year he will ascertain his profit and pay over to the Patriotic Fund every cent in excess of his average usual profits for the last five years. I don't doubt it for a moment. Every man who has received a shell contract is not necessarily a highwayman with a gun held to the Empire's head. Many a shell contractor has taken the work for the joint purpose of giving his workmen employment and furnishing the Empire with the munitions she needs. He neither sought nor received the tremendous profits some others have boasted of making. But with the air full of rumors of tremendous war profits only an investigation will clear the air and let in the light on the vexed question, "Are there profiteers? If so how did they get their contracts?" There must be a reason.

* * *

"We must take steps," said Mr. Walter Runciman, in the Imperial Parliament, "to see that Germany is unable to carry on a trade war against the entente allies after peace is signed." And it is pertinent to ask what Canada is doing in this connection. The allies are so busy whipping Germany into submission that they have little time for after-war plans. But no matter how badly the Teutons are beaten they will emerge from the war with their business organization unimpaired. They will be ready to jump in and command the world's markets the day peace is signed. They must have on hand a tremendous amount of manufactures for which the British fleet has prevented them finding a market. Once the seas are open the Germans will be busy. And the only way to curb their commercial invasion of the allied countries is to build a tariff wall around the central powers. Make it so high and strong that German trade aggressiveness will be held in check till the allies have had time to organize their commercial forces. This defensive measure is necessary from a military as well as a commercial standpoint. For so sure as Germany's commercial campaign is assured, just so soon will she proceed to prepare for another military onslaught on the world.

* * *

A national coal strike is threatened in Great Britain if conscription is put into effect. The Welsh Federation of Coal Miners, by a vote of 163 to 82, adopted a resolution in favor of a walk-out of miners in England, Wales and Scotland, if compulsory military service is inaugurated. If Lloyd George were the strong man his followers would have us believe he would take the leaders of these miners out and shoot them.

* * *

The German peril has disappeared, if indeed there ever was such a thing . . . . . Emergency? Who speaks to-day of emergency? Twelve months have passed since my right hon. friend the Prime Minister introduced his measure (for the construction of Dreadnoughts). Twelve months and more have passed since that time when he saw the German peril. He saw Germany almost ready to jump at the throat of Great Britain. He saw clouds on the horizon; he saw those clouds rent by lightning; he heard the murmurs and rumbling of distant thunder. But my right hon. friend to-day may live in peace. The atmosphere is pure, the sky is clear . . . . . From that time to this moment the relations between the countries, which were cordial in the month of September last, have been absolutely friendly. The light has been let in on that question, and we know now how much the country and the Empire and the civilized world has been deceived upon that question of so-called emergency. We know now, we have the evidence, of how the panics of which we have heard in this House more than once, are created and engineered. We have had the evidence that these panics are engineered by the armor-plate firms, who do not hesitate to create false news in order to obtain contracts for their ships.—Sir Wilfrid Laurier, Jan. 19, 1914.

But let me say this: Everyone knows that for forty years Germany has been preparing for war. For forty years Germany has believed herself invincible and destined to dominate the rest of the world.—Sir Wilfrid Laurier, at Sohmer Park, Montreal, October 15th, 1914.

On January 19 Sir Wilfrid scouted the idea of an emergency. Less than nine months later he declared that "Everyone knows" it. Was he sincere on January 19 or was he just a politician? Does he admit an entire ignorance of the facts or does he plead party exigencies? Whatever the explanation, in the face of such somersaultic statements as the above is it not mere effrontery on the part of Sir Wilfrid to jibe Speaker Sevigny about changes in his political viewpoint? Sir Wilfrid's attitude towards the serious business of to-day is that of a dilettante. He does not take this war seriously. Former friends and admirers who recall the persuasive influence of that "silver tongue," note its continued silence with bitter disappointment.

SEARCHLIGHT.

Personal

Mr. Arthur Reid, Commissioner of Public Utilities for the city of Lethbridge, Alta., has resigned. He is succeeded by Mr. Freeman.

Mr. P. A. McDonald, Winnipeg, has been appointed Public Utilities Commissioner for Manitoba, succeeding H. A. Robson, who resigned some weeks ago.

Mr. R. A. Black, C. E., of Quebec, who has been appointed chief engineer of the district of Campbellton, in place of F. O. Condon, who has removed to Moncton, has left to take up his new duties.

Mr. Norman Murray, formerly chief engineer of Weyburn, Sask., with Mrs. Murray, has left for England. Mr. Murray expects to get a commission when he reaches the Old Land.

Walter Rowland and Robert Livingston, formerly on the engineering staff of the city of Hamilton, have enlisted in 42nd battery and Army Medical Corps respectively. This makes six members of the Hamilton engineering staff who have enlisted.

Pro Patria

Mr. F. B. McFarren, general manager of the Interprovincial Brick Company of Canada, Limited, has recently received an appointment as Lieutenant in the 83rd Battalion C. E. F. Mr. McFarren is well known to the contractors and builders throughout Ontario, having been with Mussens Limited for over five years. He left Mussens in June, 1912,

Lieut. F. B. McFarren.

to accept a position with Mackenzie, Mann & Company, as purchasing agent for the Montreal Tunnel & Terminal Construction, and in April, 1914, was appointed general manager of the Interprovincial Brick Company; he is also a director of the company. Mr. E. G. Glen will be acting manager during Mr. McFarren's absence.

Obituary

A cable received at Vancouver states that Engineer F. F. Pickard, of the Federal Marine Department, was probably lost on the doomed Persia.

The death occurred recently of Mr. R. H. Bradfield, Morrisburg, Ont. The late Mr. Bradfield was prominent in the grain business in the early days, carrying on a business under the name of Bradfield Brothers.

Mr. Hilliard, former member of the town council in Renfrew, Ont., died at his home recently after a short illness. Mr. Hilliard was a building contractor and later founded a brick and tile industry in that town.

Mr. Arthur Pinder, a well-known surveyor in British Columbia, died suddenly in Victoria while walking along the street. The late Mr. Pinder was a native of England, but has been in Canada for many years. He served in the Royal Northwest Mounted Police and was a veteran of the Boer war.

The death occurred in Owen Sound of Mr. Thomas Merritt after a short illness. Mr. Merritt was born in Fredericton, N. B., and was in his 83rd year. For several years he was in the foundry business in Norwich, Ont., going from there to Brandon, Man., where he was agent for the Massey-Harris Company. Fifteen years ago he moved to Owen Sound.

Mr. Alex. Murray, son of T. Aird Murray, consulting engineer, Toronto, died last week in England, as a result of wounds received on the firing line. Mr. Murray was a student at S. P. S., Toronto, when war broke out. He went to the front with the first contingent, as a private in the Queen's Own Rifles, and served through the battles around Ypres. Some months ago he survived an attack of spinal meningitis, and returned to the trenches, only to be fatally wounded shortly afterwards. He will be buried at Newcastle, England, his birthplace.

The death occurred recently of Mr. William Crockett, St. John, N. B. Mr. Crockett was a building contractor, who learned his business in St. John.

Mr. Richard Grigg, Commissioner of Commerce for Canada and the author of several valuable works on trade and commerce, recently died very suddenly in Ottawa. Mr. Grigg was born in Plymouth, Eng., in 1847, but came to Canada at an early age and spent many years on an Ontario farm. Later he engaged in the manufacturing business in England and during that period was an active advocate of Canada and of the urgent need of better understanding of the possibilities of Canada's future in the Motherland. In 1905 he accepted a commission from the British Government to visit Canada and investigate economic conditions here. His report attracted world-wide attention, probably enjoying a larger circulation than any other blue-book ever published. In 1907 Mr. Grigg was chosen by the British Government as head of the British Intelligence Service in Canada. Four years later the Canadian Government appointed him to the position of Commissioner of Commerce with the rank of deputy-minister. This appointment proved an exceptionally happy one, Mr. Grigg's natural ability and wide experience exactly fitting him for the efficient discharge of such an important work.

British Industries Fair

In view of the great success of the British Industries Fair, held at the Agricultural Hall, London, England, from May 10th to 21st, 1914, the Imperial Board of Trade have decided to hold the second British Industries Fair at the Victoria and Albert Muesum, Kensington, London, on February 21st, 1916. The Fair will be open for 12 days.

The Fair will be conducted on the same lines as that of 1915, and is intended to extend to British Manufacturers the same advantages as have been derived by continental manufacturers from the Trade Fairs held in their respective countries. Buyers from the United Kingdom and from all parts of the world are invited to the Fair, and as it is intended for the trade only (the general public not being admitted), buyers will have an exceptional opportunity of transacting their business in a minimum of time.

Manufacturers only will be allowed to exhibit, and their exhibits will be strictly confined to goods of their own make. The Trades exhibiting will be:—Toys; Glassware; Fancy Goods; Earthenware and China; Printing; Stationery.

Admission to the Fair will be by invitation of His Majesty's Board of Trade only, and will be restricted to bona fide buyers for United Kingdom and Overseas Markets. Buyers from the Dominion of Canada visiting the United Kingdom during the course of the Fair, i.e., February 21st to March 4th, and interested in the above mentioned trades, should not fail to communicate immediately on arrival in the United Kingdom with the director, British Industries Fair, 32 Cheapside, London, E.C. It will also be to their advantage to notify the Trade Commissioner's office, 3 Beaver Hall Square, Montreal, giving particulars of the firms they represent, and their addresses in the United Kingdom. Any further information may be obtained from C. R. Woods, assistant to H. M. Trade Commissioner in Canada and Newfoundland.

Building permits in St. Catharines for December amounted to $50,700.

New and Amended Rates in the Hydro Area

We print below the new reduced electric rates for the Hydro area of the province of Ontario. The power rates are exceptionally attractive, and indicate the advantages that must accrue to contracting and manufacturing interests located within that area.

	Domestic		Commercial			Power		
Municipality.	1st 3 KWH per 100 sq. ft.	Additional per KWH	First 30 hrs. use per month.	Next 70 hrs use per month	All over 100 hrs. use per month	1st 50 hrs. use	2nd 50 hrs. use	Add'l Consump.
Acton	4.0	2.0	8	4.0	0.8	3.9	2.6	0.15
Ayr	4.5	2.25	9	4.5	0.9	3.9	2.6	0.15
Ailsa Craig..	6.5	3.25	13	6.5	1.3	...	...	....
Baden	3.5	1.75	7	3.5	0.7	3.2	2.1	0.15
Beachville .. .	4.0	2.0	8	4.0	0.8	2.2	1.4	0.15
Berlin	2.0	1.0	5	2.0	0.5	2.0	1.4	0.15
Brampton .. .	2.0	1.0	5	2.0	0.5	2.2	1.4	0.15
Brantford . ..	2.5	1.25	5	2.5	0.15	...	...	....
Caledonia .. .	3.5	1.75	7	3.5	1.75	2.5	1.7	0.15
Clinton	...	....	..	...	....	4.7	3.1	0.15
Doon	4.0	2.0	8	4.0	0.8	...	...	...
Dorchester ..	5.0	2.5	10	5.0	1.0	5.2	3.5	0.15
Drumbo	...	....	..	...	....	4.7	3.1	0.15
Dundas	2.0	1.0	5	2.0	0.15	2.1	1.4	0.15
Elora	4.0	2.0	8	4.0	0.8	...	...	....
Embro	...	....	..	...	....	4.2	2.8	0.15
Elmira	4.0	2.0	8	4.0	0.8	4.2	2.8	0.15
Exeter	5.5	2.75	11	5.5	1.1	4.2	2.8	0.15
Fergus	4.0	2.0	8	4.0	0.8	...	...	....
Galt	2.0	1.0	5	2.0	0.5	2.0	1.3	0.15
Georgetown ..	3.5	1.75	7	3.5	0.7	3.3	2.1	0.15
Glen Williams	...	....	..	...	....	3.6	2.4	0.15
Goderich	...	....	..	...	....	3.9	2.6	0.15
Guelph	2.0	1.0	5	2.0	0.5	1.5	1.0	0.15
Harriston .. .	6.0	3.0	12	6.0	1.2	4.8	3.2	0.15
Hagersville ..	4.0	2.0	8	4.0	0.8	3.6	2.4	0.15
Hamilton .. .	2.0	1.0	4	1.5	0.15	1.5	1.0	0.13
Hespeler	3.5	1.75	7	3.5	0.7	2.3	1.6	0.15
Ingersoll	3.0	1.5	6	3.0	0.6	2.1	1.4	0.15
London	2.0	1.0	4	2.0	0.4	2.0	1.3	0.15
Listowel	5.0	2.5	10	5.0	1.0	3.9	2.6	0.15
Mimico	3.0	1.5	6	3.0	0.6	2.8	1.8	0.15
Milverton .. .	5.0	2.5	10	3.0	1.0	3.9	2.6	0.15
New Hamburg.	3	1.5	6	3.0	0.6	3.2	2.1	0.15
Niagara Falls.	2.0	1.0	4	2.0	0.4	1.5	1.0	0.1
New Toronto.	3.5	1.75	7	3.5	0.7	2.8	1.8	0.15
Norwich	3.0	1.5	6	3.0	0.6	2.9	1.9	0.15
Otterville .. .	5.5	2.75	11	5.5	1.1	...	...	....
Petrolia	4.5	2.25	9	4.5	0.9	3.6	2.4	0.15
Port Credit ..	3.0	1.5	6	3.0	0.6	2.8	1.8	0.15
Pt. Dalhousie.	...	....	..	...	....	2.3	1.5	0.15
Port Stanley.	4.0	2.0	8	4.0	0.8	...	...	....
Plattsville ...	...	....	..	...	....	5.4	3.6	0.15
Preston	2.5	1.25	5	2.5	0.5	1.6	1.1	0.15
Palmerston ..	5.5	2.75	11	5.5	1.1	4.7	3.1	0.15
Rockwood ..	4.0	2.0	8	4.0	0.8	3.9	2.6	0.15
Seaforth	...	....	..	...	....	4.2	2.8	0.15
Sebringville ..	...	....	..	...	....	3.9	2.6	0.15
Simcoe	4.0	2.0	9	4.5	0.9	3.9	2.6	0.15
Strathroy .. .	4.0	2.0	8	4.0	0.8	3.6	2.4	0.15
Stratford .. .	2.5	1.25	5	2.5	0.5	3.1	2.0	0.15
St. Catharines.	2.0	1.0	5	2.0	0.15	1.6	1.0	0.16
St. Mary's ...	3.0	1.5	6	3.0	0.6	3.1	2.1	0.15
St. Thomas ..	2.0	1.0	4	2.0	0.5	1.6	1.1	0.15
Thamesford .	...	....	..	...	....	5.2	3.5	0.15
Thorndale ...	5.0	2.5	10	5.0	1.0	5.2	3.5	0.15
Tillsonburg ..	3.0	1.5	6	3.0	0.6	3.5	2.3	0.15
Tilbury	...	....	..	...	....	4.3	2.9	0.15
Toronto	2.0	1.0	5	2.5	0.5	1.5	0.5	0.15
Woodbridge .	4.0	2.0	8	1.0	0.8	...	...	....
Waterdown ..	4.0	2.0	8	4.0	0.8	3.3	2.2	0.15
Wallaceburg .	...	...	..	.	..	3.9	2.6	0.15
Weston	...	....	..	...	....	2.9	1.9	0.15
Waterloo .. .	2.0	1.0	5	2.5	0.5	.	...	..
Welland	2.0	1.0	4	2.0	0.15	1.7	1.1	0.15
Woodstock ..	2.0	1.0	5	2.0	0.5	1.8	1.2	0.15

Mainly Constructional

East and West—From Coast to Coast

Building permits for Victoria, B. C., for 1915, totalled $292,450, of which $50,000 is allowed for repairs.

The Empire Sand & Gravel Company, Limited, Toronto, have obtained a charter.

W. J. Galbraith & Company, general contractors, Montreal, Que., have registered.

Rumble, Mann & Company, railway contractors, Scotford, Alta., have been succeeded by H. Rumble & Company.

Mayor Costello and Commissioner Garden, of Calgary, are offering a reward for the safe return of the stolen city plans.

A syndicate of local capitalists in Pembroke have received an order for 35,000 shells of the value of $200,000. Machinery for the new plant is being purchased.

Lyon-Monkhouse, Limited, Winnipeg, Man., have been granted an order-in-council to change their name to the Lyon Paint and Glass Company, Limited.

1915 was an exceptionally busy one in Listowel, Ont., in the building line, many new homes of the better class having been constructed. The prospects for the present year are also very bright.

The city engineer's report for the city of Stratford shows a total expenditure of $146,011. Nearly twelve miles of permanent roadway, fifty-five miles of sidewalk, and upwards of thirty-three miles of sewers have been laid during 1915.

The Toronto Board of Harbor Commissioners have passed their estimates for the year. They will spend in 1916 $2,500,000—$650,000 for reclamation work, $100,000 for the proposed lift bridge over the Don River at Cherry Street, and the remainder for different construction works.

Mr. J. R. Robinson was elected president of the Master House Painters and Decorators' Association at the annual meeting held in I. O. F. Temple, College Street, Toronto, on the 6th inst. Mr. C. Mandon was elected second vice-president, and Mr. F. J. Cox secretary-treasurer.

The Chatham (Ont.) Builders' Exchange held their annual election of officers on the 4th inst. The following officers were chosen for the ensuing year: president, T. Rayment; first vice-president, A. Tomlinson; second vice-president, C. R. Guy; treasurer, T. McKie; secretary, W. Malvern; auditors, B. Blonde and J. A. Hildreth.

The Precision Manufacturing Company, Limited, has been organized, with head office at St. Catharines, and a capital of sixty thousand dollars, "to manufacture, buy, sell, and generally deal in all kinds of machinery, tools, instruments, and metal articles." The provisional directors are John Frampton, Arthur W. Varey, and M. J. McCarron.

The Eastern Canadian Copper Corporation, Limited, has been incorporated with a capital stock of $990,000, for the purpose of working gold, silver, copper, coal, iron, lead, and other mines. The chief place of business of the company will be Montreal. The incorporators are E. T. Sill, A. J. Perkins, A. O. Whitworth, L. Horsford, and J. T. Whitworth, all of Montreal.

Although the building permits issued in Niagara Falls, Ont., in 1915 totalled $186,906 less in value than those for the preceding year, the figures for the last half of the year that is just closed show a tremendous increase over those for the corresponding months of the previous year. December permits alone amounted to approximately $120,000. Conditions in this city point to a great increase in building activity during 1916.

The December report of the British Amalgamated Society of Engineers shows that the membership has advanced from 173,629 to 204,162 in eleven months, and that funds have increased $1,185,350 in ten months. It is estimated, taking into account the increase in the price of piece work and the amount of overtime worked, that the earnings of members must have been increased by about $10,000,000 a year.

The following is the comparative table, showing the building records of 1915 as contrasted with those of 1914:—

	1914	1915
Montreal	$17,394,244	$7,486,221
Toronto	20,684,288	6,651,889
Winnipeg	12,160,950	1,826,300
Ottawa	4,397,920	1,605,160
Hamilton	3,703,865	1,523,248
Vancouver	4,484,476	1,504,300
London	1,837,735	1,207,630
Halifax	879,320	1,063,985

During the year the Government has built by direct grant 129 miles of new roads and repaired 471 miles of old roads. It has also aided municipalities to build 119 miles of new roads under by-law and to repair 1,250 miles of old roads, thus employing a total of over 10,500 men. The most important piece of work yet undertaken by any provincial government is the high road which will eventually run from Windsor to Toronto and from there to Ottawa and Montreal, connecting at the latter point with the Montreal-New York highway. From Windsor to Ottawa this road will follow the old highway, which was the main artery of settlement in the early history of the province.

Considering the cities through which this will run, and including the population within a four-mile belt on each side, it will serve one-half of the entire population of the province. The section between Toronto and Hamilton, about thirty-six miles long, may be considered the most important. It is almost completely graded, the smaller bridges and culverts are practically finished, and over seventeen miles of concrete pavement have been laid.

The Bricklayers, Masons and Plasterers' International Union of America opened their fifth biennial and forty-fifth convention yesterday morning at the new Central Technical School, Toronto, after parading to that point from the Carls-Rite Hotel, headed by the band of the 48th Highlanders. There were between three hundred and four hundred delegates at the opening, and it is expected that by the end of the week there will be over five hundred in the city.

On arrival at the school the delegates were welcomed by the Hon. F. G. Macdiarmid, who extended to them the freedom of the Province on behalf of Premier Hearst. Mr. Macdiarmid referred to the advance of legislation favorable to the workingmen in the Province of Ontario. He said that after the war Canada would emerge with her credit unbroken, "and when we emerge the brotherhood of man will have a meaning it has never had before."

Mayor Church, representing the city; James Simpson, representing the Trades and Labor Congress of Canada; John Vick, representing the local Bricklayers' Union; James Richardson, representing the Toronto Trades and Labor Council; John Sutherland, representing the Building Trades League, and Dr. A. C. McKay, Principal of the Technical School, also extended welcomes to the visitors.

Mr. W. J. Bowes, who was elected president of the union in 1904, acknowledged the addresses and thanked the various representatives for the cordiality with which the delegates had been received since their arrival in the city.

Sufficient work has now been done at Saanich observatory to give some general idea of what the completed structure will be like. Next month should see a start on the construction of the dome. The concrete base of the structure is in place, and such steel work as can be done pending the return of Dr. Plaskett is now being hastened by the contractors, the McAlpine Robertson Company.

An increase in the price of the tenders for five million bricks resulted in the Montreal Board of Control rejecting the bids of the two companies tendering. The National Brick Company asked $11 per thousand and the St. Lawrence Brick Company $11.25 per thousand, the prices last year being $8.50 and $9.00 per thousand. The bricks are required for sewer work, and the Mayor declared that if no better prices are made the city will consider the use of cement. Fresh tenders are to be called. The price includes cartage. Owing to the large stocks, the companies in 1915 offered the bricks at very low quotations, but this year the makers are asking prices which will allow a reasonable profit.

The New York Continental Jewell Filtration Company, Montreal, is installing a plant at Macdonald College, St. Anne de Bellevue, P. Q. The company has also obtained a contract at Berthier, P. Q., where work will be commenced in the spring. Both plants have a capacity of 300,000 U. S. gallons per day.

A commission representing the city of Montreal, Montreal West, St. Pierre, Lachine, and the Conseil Superieur d'Hygiene have presented a report in favor of converting the St. Pierre River from an open into a covered sewer at a cost of $610,000; also proposing that a barrier be constructed to prevent the St. Lawrence River backing up the open sewer and the construction of a pump house at a cost of $120,000—or $95,000 if electricity be used. The St. Pierre receives the sewage and household and surface water of several municipalities and is nothing less, the report says, than an open sewer.

At the annual meeting of the Quebec branch of the Canadian Society of Civil Engineers held in Quebec on January 11 the following officers were elected: president, Mr. A. E. Doucet; secretary-treasurer, Mr. Ivan E. Vallee; councillors, Messrs. Altheod Tremblay, Gabriel Henry and T. A. J. Forrester.

The Dominion Railway Board have ordered a grade separation at the junction of King Street and the Toronto, Hamilton & Buffalo Railway, Hamilton, Ont., by means of a bridge over the tracks.

Good roads constructed last year in the province of Quebec with the aid and under the supervision of the provincial government, totalled 436.3 miles. Of the total roads constructed 205.6 were macadam, the balance being stone foundation. Since 1911 the province of Quebec has constructed 1,667.67 miles of good road in all sections. The Montreal-Quebec route is on the eve of being completed, which shows that little remains to be done on the Levis-Jackman road. Asphalt work is to be continued on the King Edward Highway.

Canadian Nitro Products, Limited, have been incorporated with capital stock of $5,000,000, to carry on business in Toronto. They will manufacture and deal in war munitions, explosives and ammunition of all kinds. The provisional directors are Edmund Hale Austin, Thomas Neville Polle, Charles Evans-Lewis, D. Finemark and F. Godson.

The British Munitions Company, Limited, have obtained a charter to do business in the city of Montreal; capital stock $50,000. The provisional directors are W. R. Lorimer Shanks, F. G. Bush, G. R. Drennan, Michael J. O'Brien and H. W. Jackson. The company will manufacture and deal in time fuses and munitions generally.

As a result of the success last year of the first conference on highway construction for county road superintendents and engineers, it has been decided to continue the course during the second week of February. Mr. W. A. McLean, Provincial Engineer of Highways, in a foreword to the programme, says: "In an organization covering the southern portion of the Province of Ontario, uniformity of methods and personal touch between the engineers of the department and the county superintendents are essential for the efficient carrying on of highway improvement. The series of lectures on highway construction is undertaken more especially as a means of giving departmental instruction to county engineers and superintendents who are in charge of roads subsidized by the Provincial Government under the highway improvement act."

The conference opens on Tuesday, February 8, and closes on Friday, the 11th. The introductory address will be given by Hon. F. G. Macdiarmid, Minister of Public Works and Highways, and the speakers at the various sessions will include: Messrs. R. C. Muir, A. H. Parker, G. C. Parker, A. A. Smith, W. Huber, George Hogarth, M. A. Kemp, W. A. McLean, W. H. Losee, H. S. Van Scoyoc (Chief Engineer, Toronto-Hamilton Highway Commission), R. M. Smith, Arthur Sedgwick, T. M. De Blois.

Despite the opposition offered to the proposed diversion of the route of the Lake Shore highway from the Lake Shore Road to Queen Street through Mimico, New Toronto and Etobicoke, the members of the three Councils at the conclusion of a conference with Mr. George H. Gooderham, M.P.P., chairman of the Toronto-Hamilton Highway Commission, decided to support the change in route. Mr. Gooderham, in pointing out the material saving which would be effected by the adoption of the Queen Street route, classed the original Lake Shore route as prohibitive in cost, although it was in all probability the people's thoroughfare. To construct the road along the Lake Shore would cost at least $404,000, with the probability that this figure would be increased about $30,000 more owing to land damages. In comparison with this, to build the highway along Queen Street, and thus avoid the big items of expense encountered on the Lake Shore would only cost about $227,000. Under the new plan the road will leave the Lake Shore at the Etobicoke Township boundary line (Etobicoke Creek) and will thence continue along Queen Street through Mimico, New Toronto and Etobicoke, connecting again with the Lake Shore at the westerly limits of New Toronto.

The members of the Toronto Township Council interviewed Sir Adam Beck, chairman of the Ontario Hydro-Electric Power Commission, recently, and discussed the Hydro-Electric radial by-law to be submitted shortly. It is planned to hold the vote on the by-law early next month. Toronto Township's share of the cost of the line is about $355,000.

Construction Features of Mexico Plant

(Concluded from page 62)

generators to produce additional power. But besides this, two 16,000 h. p. units of approximately similar design were added.

The whole design and construction of this plant is of the greatest interest, even though it is not today the newest hydro-electric plant, and when a government in Mexico is formed that compares in any way with the strong effective government of General Diaz, this plant will be of tremendous benefit to the future development of this section of Mexico. It is a remarkable thing that, in spite of all the disturbances in that unfortunate country, the Necaxa plant has never been interfered with to any serious extent.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Hull, Que.
Fire Chief Tessier has recommended that watermains be laid to Tetreville. City Clerk, H. Boulay.

Lynn Creek Valley, B.C.
The construction of a roadway up the Lynn Creek Valley to the Zinc Mines is being considered. The Municipal Council of North Vancouver will approach the Provincial Government for a grant of $5,000 towards the cost of the work, the balance to be provided by the Council and mining interests. Estimated cost, $10,000.

Markham, Ont.
A by-law has been carried providing for the borrowing of $5,000 for the construction of sidewalks. The Village Council will purchase material. Clerk, M. White.

Merritton, Ont.
The Town Council are considering the construction of sewers on a number of streets and the laying of pavement on a portion of Merritt Street. Engineer, F. Rutherford, 24 Queen Street, St. Catharines.

Vancouver, B.C.
Estimates are being prepared by A. D. Creer, Engineer to the Vancouver Sewage Board, on the probable saving if the Stanley Park Causeway and trunk sewer are constructed together. Tenders may be called about the end of January.

Winnipeg, Man.
Plans are being prepared for the construction of watermains to the proposed Institute for the Deaf and Blind, under an arrangement between the Government and the City.

Railroads, and Bridges Wharves

Fort Erie, Ont.
The Buffalo, Fort Erie Ferry & Railway Company, care of F. V. E. Bardol, Room 400, D. S. Morgan Building, Buffalo, N.Y., will apply to the Ontario Legislature for permission to construct a number of extensions to their system.

Hullett Township, Ont.
James Campbell, Secretary to the Township Council, will receive tenders until 2 p.m., February 3rd, for the construction of a steel bridge over Walkerburn Creek. Abutments and flooring of cement construction.

Nanaimo, B.C.
The City Council are considering the erection of a bridge over the Mill Stream and will submit a by-law. Estimated cost, $14,000. Clerk, A. L. Rattray.

Victoria, B.C.
The Canadian Northern Railway Company, Toronto, have prepared plans for a bridge to be erected over Selkirk Water, and have forwarded them to the Federal Government for approval.

Wardsville, Ont.
The bridge for which the County Council are having plans prepared is to be of steel construction, 85 feet span, with creosoted wood block flooring.

Winnipeg, Man.
The City Council are considering the construction of a bridge over the Winnipeg River at Point du Bois, to replace the present temporary structure. Estimated cost, $99,742. Secretary, M. Peterson.

Public Buildings, Churches and Schools

Auckland, Que.
The School Board contemplate the erection of a school, estimated to cost $5,000. Secretary, J. B. Beauvais, Auckland.

Chambly, Que.
The erection of a school is being considered by the School Board. Estimated cost, $3,000. Secretary, G. C. Wallis.

Charlottetown, P.E.I.
Repairs to the First Methodist Church have been decided upon. Work will include the installation of a steam heating system and seating and interior decoration. Secretary of the Committee, E. H. Beer, 134 Richmond Street.

Ditton, Que.
The School Board are considering the erection of three schools, estimated to cost $4,400. Secretary, Tancrede Halle, Ditton.

Hamilton, Ont.
The Board of Education have been informed that a new Collegiate Institute will have to be built during the year, in consequence of overcrowding. Secretary, R. H. Foster, City Hall.

Hampden, Que.
The erection of a school is contemplated. Approximate cost, $5,000. Secretary to the School Board, John Black, Hampden.

Palmerston, Ont.
In connection with the Post Office now in course of erection, the roofing is being done by day labor. Plastering and painting contracts not yet awarded.

Portage la Prairie, Man.
The Public School Board will receive tenders until January 25th for salvage of the walls of the school which was recently destroyed by fire, preparatory to the erection of a new building. Chairman, Dr. A. P. MacKinnon.

Richelieu Village, Que.
The erection of a school is contemplated by the School Board. Estimated cost, $3,000. Secretary, J. C. Bashaw.

Spaulding, Que.
The School Board are considering the erection of a school, estimated to cost $5,000. Secretary, J. Cote, Spaulding.

Stanstead, Que.
The Roman Catholic Congregation are considering the rebuilding of their Church, which was destroyed in the recent fire. Curate, Rev. B. X. Cruveiller

St. Boniface, Man.
A by-law will be submitted to the ratepayers shortly to provide for the erection of an addition to the Provencher School at an approximate cost of $65,000. Chairman of the School Board, J. A. Marion.

Ste. Beatrice, Que.
The erection of a school is contemplated by the School Board. Estimated cost, $3,000. Secretary, Francois Parent.

St. Hubert, Que.
The School Board contemplate the construction of a school at an approximate cost of $3,500. Secretary, W. R. Kennedy, Springfield Park Post Office.

Toronto, Ont.
The Board of Education are considering the construction of an Industrial Farm School, to consist of buildings of the cottage type, each capable of accommodating fifty inmates. Estimated cost, between $25,000 and $50,000 each. Secretary of the Committee, Dr. Helen McMurchy.

CONTRACTS AWARDED

Brighton, Ont.
The contract for plastering at the new school has been awarded to T. Gander & Son, 251 Gladstone Avenue, Toronto.

Louisburg, C.B.
The contract for heating and plumbing at the new school has been let by the Town Council to Charles Thompson, care of Angus McAskill, Glace Bay, N.S.

Verdun, Que.
The contract for painting required in connection with the Nurses' Residence which has been erected at the Protestant Hospital for the Insane, 209 La Salle Road, has been awarded to the general contractors, A. F. Byers & Company, Limited, 340 University Street, Montreal.

Westport, Ont.
The general contract for the erection of St. Edward's Presbytery has been awarded to C. J. Speagle, Westport. Estimated cost, $10,000. Don Valley pressed brick will be used.

Business Buildings and Industrial Plants

Aylmer, Que.
Henry Kuntz, 424 Queen Street, Ottawa, has purchased the site of the Hotel Victoria, which was destroyed by fire,

and contemplates the erection of a large summer residence or hotel.

Cote St. Michel, Que.
The Dominion Government Department of Public Works intend to erect a powerful wireless station to replace the one at Maisonneuve. Secretary, R. C. Desrochers, Ottawa.

Digby, N.S.
Work is progressing on the erection of an office and warehouse for the Nova Scotia Fish Company. Construction is supervised by W. Turnbull.

Forest, Ont.
The Town Council are having plans prepared for fitting up the Town Buildings for Military purposes. Work will include the installation of heating apparatus and general interior fittings. Reeve, F. Patterson.

Halifax, N.S.
The Imperial Oil Company, 311 Dominion Bank Building, Toronto, are building two oil tanks on Richmond St. Special iron construction, concrete foundation. Manager, S. S. Shatford, Halifax.

Hamilton, Ont.
The Royal Hamilton Yacht Club have decided to erect a club house to replace the building which was burnt down last autumn. Work will start in the spring. Estimated cost, $25,000. Secretary, E. J. Renwick.

Kingston, Ont.
The City Council have had plans prepared for alterations to the Market Buildings on King Street for the accommodation of troops. Work will include the installation of closets, sinks, ranges, bunks, etc. Tenders will be called shortly. Clerk, W. W. Sands.

Loco, B.C.
The Imperial Oil Company, Limited, 404 Abbott Street, Vancouver, contemplate the erection of an office building and club house, at an estimated cost of $18,000. Tenders will be called later.

London, Ont.
The by-law to provide for the establishment of a live stock market has been defeated.

Medicine Hat, Alta.
Fefferman Bros., clothing merchants, have purchased a site for the erection of a business block, and will probably start work in the spring. Architect, W. H. Bourne, Huckvale Block.

New Westminster, B.C.
Local architects are now preparing competitive plans for a market building to be erected for the City Council. Tenders will be called as soon as the design is decided upon. Approximate cost, $35,000. Clerk, W. A. Duncan.

Ottawa, Ont.
The Ottawa Brass Manufacturing Company, 367 Wellington Street, are considering the erection of an addition to their factory. Brick construction.

Owen Sound, Ont.
Work by day labor is about to start on remodelling the Pacific Hotel for the Owen Sound Shoe Manufacturing Company, Limited. Promoter, W. E. Wilson.

Peterboro, Ont.
Work is about to start on the erection of an addition to the premises of the Auburn Woollen Mills, River Road. A quantity of steel and other material is already on the site.

St. Thomas, Ont.
The Wabash Railway Company, St. Louis, Mo., have had plans prepared for an addition to their roundhouse. Work will probably commence at an early date.

Strathroy, Ont.
R. M. Pincombe is about to make repairs to his mill, part of which recently collapsed. Approximate cost, $3,500.

A by-law has been carried authorizing the construction of water and electric services to the proposed basket factory. Owner, George Rivers.

Three Rivers, Que.
The chemical factory which is now in course of construction for the City Council will be occupied by Contant, Monette & Pion, 861 Ontario Street E., Montreal, who are in the market for iron tanks, vats, stills and retorts for the manufacture of potash and heavy chemicals, etc.

Toronto, Ont.
The Board of Control will receive tenders until February 1st for the erection of an addition to the abattoir on Tecumseh Street. Plans at office of the Property Commissioner, City Hall, and of D. W. Wright, Manager, Civic Abattoir.

Weedon, Que.
The Weedon Chemical Company have commenced the rebuilding of their plant. Equipment has been purchased.

Whalen, Ont.
John Rowell will shortly start work on the erection of a reinforced concrete silo.

Patrick McGee intends to build a reinforced concrete silo. Work will start as soon as possible.

CONTRACTS AWARDED

Esquimalt, B.C.
Work is progressing on the construction of an oil storage plant for the Imperial Oil Company, Limited, 404 Abbott Street, Vancouver. The contract for erecting the warehouse, stable, office and residence has been awarded to the Dominion Construction Company, 509 Richards Street, Vancouver. Frame, concrete and galvanized iron construction.

Halifax, N.S.
Work has been started on repairs to the business block at Granville and Sackville Streets for A. P. Downey, 241 Robie Street. The general, masonry, carpentry, roofing, plastering and painting contracts have been awarded to the Halifax Building Company, and the heating to Longard Bros., 213 Hollis St. Frame construction, stone foundation, felt and gravel roofing. Approximate cost, $10,000.

Montreal, Que.
The following contracts have been let in connection with the foundry now in course of erection for the Williams Manufacturing Company, Limited, St. James Street W.:—masonry and carpentry, Reid, McGregor & Reid, 511 St. Catharines Street W.; roofing, Douglas Bros., 19 St. Maurice Street; glazing, Hobbs Manufacturing Company, 43 St. Maurice Street; heating and plumbing, L. E. Moulton & Company, Limited, 142 Inspector Street; electrical work, Collyer & Brock, 131 St. Alexander Street.

In connection with the machine shop in course of erection on Bourget Street for the Williams Manufacturing Company, Limited, 1789 St. James Street W., the contract for supply of cut stone has been let to John Quinlan & Company, 4412 St. Catherine Street, Westmount, and for metal sash to Steel & Radiation Ltd., 301 University Street.

Ottawa, Ont.
Work has been started on alterations to a store for James Hope & Sons, Sparks Street. The general contract has been awarded to J. St. Clair & Company, Chateau Laurier. Approximate cost, $3,500.

Paris, Ont.
The contract for roofing in connection with the factory which has been erected for the Paris Wincey Mills Company, Limited, has been awarded to Turnbull Cutcliffe, Limited, 50 Colborne Street, Brantford.

Peterborough, Ont.
Work has been started on the erection of an addition to the Auburn Woollen Mills, River Road. The general, carpentry, roofing and painting contracts have been let to C. Rutherford, care of owners, and the contract for steel to Hepburn & Disher, Limited, 18 Van Horne Street, Toronto. Owners will do heating.

Sherbrooke, Que.
Work has been started on the erection of an addition to the premises of Walter Blue & Company, Limited, 8 King St. The general, masonry, carpentry, heating, plumbing and interior fittings contracts have been let to Anglin's Limited, 65 Victoria Street, Montreal. Roofing, painting and electrical work not yet let.

St. Anne de Bellevue, Que.
Work is about to start on the construction of a filtration plant at Macdonald College. The equipment will be supplied by the New York Continental Jewell Filtration Company, New Birks Building, Montreal, and the work done by the College employees. Approximate cost, $16,000.

St. Catharines, Ont.
The contract for carpentry required in alatration to a building for A. Puccini & Company, 55 Front Street E., Toronto, has been let to Davis Bros., Niagara St.; the plumbing and galvanized iron work to W. Riddell & Son, 283 St. Paul Street, and the contract for the installation of an elevator to the Turnbull Elevator Company, John Street, Toronto.

Toronto, Ont.
The general contract for the erection of a warehouse at Wilton Avenue and Dalhousie Street has been awarded by the Robert Simpson Company, Limited, 176 Yonge Street, to Wells Bros. Company of Canada, Limited, Monadnock Building, Chicago, Ill. Reinforced concrete construction, steel sash. Approximate cost, $100,000. Work will start in the spring.

The contract for steel sash required in the erection of an addition to the factory of the Canada Metal Company, Limited, Fraser Avenue, has been let to Steel & Radiation, Limited, Fraser Avenue.

and for steel to Hepburn & Disher, Limited, 18 Van Horne Street. Roofing, wiring and painting not yet awarded.

Vancouver, B.C.
Work has been started on the erection of on addition to the premises of the Hudson's Bay Company, Georgia Street. The contract for excavation has been let to Campbell Bros., 1623 Bismarck Street, and the structural steel to Canadian Northwest Steel Company, Limited, Vancouver. Tenders on plastering, painting, mill work, sheet metal and roofing are being received by the general contractors, British Columbia Construction & Engineering Company, 516 Standard Bank Building.

Residences

Bethel, Ont.
A. Blain, Bethel, Glencoe, Ont., is considering the erection of a residence to replace that recently destroyed by fire. Approximate cost, $3,000.

Hensall, Ont.
Work will start in the spring on the erection of two residences for R. Cudmore. Plans are being drawn by T. Welsh, Hensall. Brick, frame and concrete construction. Estimated cost, $3,000.

Lachine, Que.
Arthur Fournier, 89 Third Avenue, is building a residence on Third Avenue, is building a residence on Third Avenue, estimated to cost $5,000. Work by day labor.

Leamington, Ont.
Mrs. Edith Davidson, Mill Street, contemplates the erection of a residence to replace that recently destroyed by fire.

Montreal, Que.
Work by day labor has been started on the erection of a residence for D. Baillargeon, 1960 Chabot Street. Brick construction, concrete foundation, felt and gravel roofing. Approximate cost, $4,000.

Ottawa, Ont.
The erection of a Protestant Infants' Home is being considered. Convenor, Mrs. Gordon Cumming, 24 Lisgar Street.

James S. Wilson & Petregorsky, 256 Kent Street, are considering the erection of apartments on Laurier Avenue East. Brick construction, concrete and brick foundation, felt and gravel roofing. Estimated cost, $6,000.

Quebec, Que.
J. & A. Tremblay, 79 Second Avenue, Limoilou, has commenced the erection of a residence, estimated to cost $3,000. Frame and brick construction, felt and gravel roofing.

Work on the erection of a residence has been started by E. Cauchon, 84 Lamontagne Avenue, Domaine Lairet, Quebec. Frame and brick construction, metal and asbestos roofing. Estimated cost, $3,000.

W. Morel, Fourth Avenue, Limoilou, has commenced the erection of a residence, estimated to cost $3,000. Frame and brick construction, metal and asbestos roofing.

Toronto, Ont.
R. J. Roger, 196 John Street, has commenced the erection of a residence on Glendale Avenue, estimated to cost $3,500. Smaller trades will be let. Brick construction, shingle roofing.

E. Edmonds, 105 Oakwood Avenue, is building a residence at 37 Thome Crescent. Brick construction, slate roofing. Estimated cost, $3,800.

J. Thorn, 221 Woodbine Avenue, is building two residences on Brookside Drive, estimated to cost $3,600. Brick construction, shingle roofing.

CONTRACTS AWARDED

Halifax, N.S.
The Eastern Investment Corporation, Cragg Building, have let the following contracts in connection with the flats and residences which they are building on Jennings, Jubilee, Larch, Le Marchant and Mott Streets:—heating, Longard Bros., 213 Hollis Street; plumbing, W. S. Craig, 316 Upper Water Street; electrical work, J. Starr, Son & Company, Granville Street.

Kentville, N.S.
In connection with the residence which is being erected at the Sanatorium for the Provincial Department of Mines and Works, Halifax, the contract for heating and plumbing has been awarded to W. Rockwell & Company, Wolfville. Painting by the general contractor.

Lachine, Que.
The general contract for the erection of a residence on St. Catherine Street for Jeffrey Lord, 109 Fourth Avenue, has been let to E. Bourbonnais, 181 Third Avenue. Brick construction, concrete foundation, felt and gravel roofing. Estimated cost, $3,000.

Fournier & Company, Limited, Victoria Street and Second Avenue, have commenced the erection of two flats for Isidor Seidman, 46 Fourth Avenue. Brick veneer construction, concrete foundation, felt and gravel roofing. Estimated cost, $3,000.

Montreal, Que.
The contract for heating required in connection with the residence which has been erected on La Salle Street by J. T. Legault, 30 St. James Street, has been let to W. Theriault, 283 William David Street.

Ottawa, Ont.
The following contracts have been let in connection with the residence in course of erection on Nichols Street for the Estate of John O'Leary, 208 Laurier Avenue:—brick work, S. Lasage; plastering, Peter Bopry, 13 Heney Street; heating, Pease Foundry Company, Limited, 287 Lyon Street; plumbing, Coldrey & Chapman, Albert Street. Painting not yet awarded. Electrical work by day labor.

In connection with the residence in course of erection for H. L. Morrison, 15 Ossington Avenue, the contract for heating and plumbing has been let to Gervin & Lillico, 1095 Bank Street, and the electrical work to the Dominion Electric Construction Company, 417 Sparks Street.

The contract for heating and plumbing required at the residence which is being built on Ossington Avenue by Bower Bros., 133 Hopewell Avenue, has been awarded to Gervin & Lillico, 1095 Bank Street, and the electrical work to the Dominion Electric Construction Company, 417 Sparks Street.

W. H. Tate, Bank Street, has let the general contract for alterations and additions to apartments on Somerset Street to J. D. & F. Wilson, 482 Bank Street. Brick veneer construction, felt and gravel roofing. Approximate cost, $6,000.

Peterborough, Ont.
The general contract for the erection of two cottages for the City Council has been awarded to Daniel Couglin.

Power Plants, Electricity and Telephones

Forest, Ont.
The by-law providing for the installation of a hydro electric system has been carried. Town Clerk, R. Karr.

Hensall, Ont.
A by-law to authorize the installation of a hydro electric light and power system will be submitted to the ratepayers on January 24th. Town Clerk, A. Murdoch.

Montreal, Que.
The Montreal Public Service Corporation, 263 St. James Street, are having plans prepared for an addition to their steam power plant. The first unit will be of 15,000 h.p. capacity, which will be increased as demand warrants to an ultimate capacity of 60,000 h.p.

Plans are being prepared by the Montreal Tramways Company, 78 Craig St., for an addition to their steam generating plant, estimated to cost between $2,000,000 and $3,000,000. The first unit will be of 17,000 h.p., to be increased ultimately to 60,000 h.p.

Park Hill, Ont.
The by-law authorizing the installation of a hydro electric system has been carried. Town Clerk, J. H. Laughton.

Waldeck, Sask.
The Beaver Flat Rural Telephone Company have been authorized to borrow $12,000 for the construction of their proposed system. Treasurer, J. K. Austring, Waldeck.

Zurich, Ont.
The by-law providing for the installation of a hydro electric system has been carried. Clerk to Hay Township Council, Fred Hess, Sr., Zurich.

CONTRACTS AWARDED

Sherbrooke, Que.
The contract for supply of a turbine has been let by the City Council to the Jenckes Machine Company, Lansdowne Street, subject to the approval of the Committee in charge.

Fires

Bridgewater, N.S.
Fire has destroyed the Fairview Hotel, owned by W. E. Awalt. Loss, $16,000; insurance, $4,500.

Brooklyn, N.S.
The store and residence owned by Clifford Gardner has been totally destroyed by fire. Loss, about $2,000, covered by insurance.

Buckingham, Que.
Fire has completely destroyed the Alexandra Hotel, owned by J. A. Bernardin & Company. Loss, $20,000; insurance, $12,000.

Calgary, Alta.
The store and stock of the Western Commercial Liquor Company has been damaged by fire to the extent of about $80,000. Loss is covered by insurance.

Dundas, Ont.
Fire has destroyed the barns and stable owned by Richard Morley, Osborne Hotel. Loss, $3,000, partially covered by insurance. Owner contemplates rebuilding.

Ethel, Ont.
The residence of S. Bartley has been totally destroyed by fire. Loss is partially insured.

Haileybury, Ont.
The hotel owned by Otto Knapp has been entirely destroyed by fire. Loss, $90,000, insurance $62,000. Owner will probably rebuild in the spring.

McGillivray, B.C.
The large sawmill owned by the Riverside Lumber Company, Limited, Riverside, Calgary, Alta., has been totally destroyed. Loss, $65,000. The Company intend to rebuild immediately.

Middle Sackville, N.B.
The factory of the Standard Boot & Shoe Company has been damaged by fire. A number of expensive machines were destroyed.

Minnedosa, Man.
The residence of Thomas Beddome has been entirely destroyed by fire. Loss, $3,000, insurance, $1,800.

Niagara Falls, Ont.
Fire has destroyed the residence of Hugh McLean, 340 Victoria Avenue. Loss is covered by insurance.

Normandale, Ont.
The residence of George Stanley has been entirely destroyed by fire. Owner is considering rebuilding in the spring.

Ottawa, Ont.
Fire has destroyed stores and apartments at Wellington and Sherbrooke Streets, the property of William Joynt, 990 Wellington Street. Owner will rebuild at an early date. Loss, about $4,500.

Sault Ste. Marie, Ont.
The International Hotel has been completely destroyed by fire. Loss, about $250,000; insurance, $50,000. Manager, C. A. Pollock.

Sillery, Que.
Fire has destroyed a residence owned by J. L. Heureux, Sillery Village. Loss, $6,000.

St. John, N.B.
A store at 56 Mill Street, the property of J. Marcus, 30 Dock Street, has been damaged by fire. Loss on buildings and stock, $4,000, covered by insurance.

Toronto, Ont.
Fire has damaged the Union Station to the extent of about $10,000. Superintendent, J. J. Beck, Front Street.

Trenton, Ont.
Fire has damaged the stock and property of the Trenton Cooperage Mills to the extent of about $150,000.

Miscellaneous

Goodwood, Ont.
Tenders will be received until February 1st by the Reeve on the supply of a quantity of cedar timber.

Gravenhurst, Ont.
The Gravenhurst Electric Light & Water Commission are receiving tenders on the supply of 200 cedar poles, between 30 and 45 feet long, and not less than 6 inches top and 10 inches butt. Secretary, W. H. Butterworth.

Hull, Que.
The City Council are considering the purchase of a combination chemical and hose auto truck and a quantity of hose. Clerk, H. Boulay.

CONTRACTS AWARDED

Ottawa, Ont.
The City Council have let the following contracts:—supply of one motor, Shepherd & Cameron, Queen Street; two pumps, Mussens Limited, 318 St. James Street, Montreal; boiler, Ottawa Boiler & Steel Works, 135 Broad Street.

Wheel Tax Would Provide Road Maintenance Funds

For the maintenance of roads in North Carolina, Joseph Hyde Pratt, secretary of the State Highway Commission, has recently advocated the imposition of a "wheel tax," based upon tire widths and the amount of damage to highway surfaces caused by individual vehicles. All funds thus collected would be used exclusively for maintenance work. Under the suggested wheel tax a wagon capable of carrying 4,000 lbs. and with wheels having tires 2 to 2½ inches in width, would pay a much greater tax than the same capacity wagon whose wheels have tires 6 inches wide. If the front wheel of such a wagon should not have the same tread as the rear wheels the tax would be still lower. The heavier the load the wagon will hold, the higher, proportionately, will be the wheel tax, and the wider the tire, the lower the wheel tax. With automobiles the horsepower and weight of machine will determine the wheel tax. An equitable scale of the wheel tax can be devised, Dr. Pratt believes, which will not work a hardship on any one and the revenue derived from it will maintain the roads.

In West Virginia lumber wagons have been doing a great deal of damage to the public roads and the county engineers are now putting in force an act recently passed at the extraordinary session of the last legislature, which is as follows:

Persons, firms, etc., making continuous use of any piece of the country road or driving thereon any wagon and by such use causing more than the usual wear, may be compelled to put thereon a section man or men and keep or assist in keeping said road in such repair as the court may order. Any person disobeying or refusing such orders shall be adjudged guilty of a misdemeanor, and upon conviction thereof fined not to exceed $50, or imprisonment, or both.

This action of the West Virginia Legislature, Dr. Pratt thinks, is a move in the right direction, but he is still of the opinion that the wheel tax method of furnishing a maintenance fund and of controlling the damage that vehicles do to roads, is by far the more practical and effective one.

$2,000 Spent by New Society Saves $3,000 to Profession

More than one hundred engineers put in touch with positions, at no cost to the engineer or employer, thereby saving them about $3,000, all at a total cost of less than $2,000, is the gist of the report of the activities of the service clearing house of the American Association of Engineers, presented by the secretary at the first annual convention held in Chicago, December 10 and 11. The $2,000 represents all the moneys spent since this organization, devoted to the welfare of the engineer, started its existence 7 months ago. The work of the clearing house has practically all been done since September 15.

In one-half of the application filed, reported the secretary, there is a steady decrease in the average pay of the engineer from $150 in 1910 to $110 now, a fact that he felt ought to be given serious consideration. While dishonest and incompetent employment agencies are not nearly as prevalent as commonly believed, still instances were given of exorbitant fees charged for positions held only a few days.

The organization has now about 300 members and received 40 additional applications at the Saturday afternoon meeting, which was attended by 400 engineers, 200 of whom were visitors.

In an address by J. H. Prior, chief engineer of the Illinois Public Utilities Commission, on "The Economic Aspects of Engineering Pay," he demonstrated by diagrams that the pay of the lowest "marginal" man in an organization had a direct effect on that of the highest paid. He also pictured the law of supply and demand, showing that the same result was obtained in case free bargaining was indulged in and full knowledge of conditions was known by both the engineer and his prospective employer.

Prof. F. H. Newell outlined the problems of the engineer from the welfare standpoint. He emphasized the idea that this organization is in no wise antagonizing any other good movement, but will stimulate and help the existing organizations far more than it will draw from their membership. He spoke at length on the duty of the society to the engineer and suggested that younger men be chosen more often as officers.

Hauling Equipment that Proved Economical on Road Work

Fifteen teams and ten men were saved on a road contract recently carried out by Thomas Levene near Griffin, Ill., by the use of a White truck and trailer and Lee portable unloaders. In building the asphalt-penetration road, surfaced with three grades of stone, nine dump wagons, each with a team and driver, and three asphalt penetration tanks, each requiring two teams, a driver and a fireman, were in use before the truck was employed. The truck and trailer, making the 4½ mile round trip in less than an hour, including stops, not only hauled as much stone as the nine teams, but also picked up the empty and full tanks as the work progressed, and made the trip from the siding to the job so quickly that firemen were not needed on the tanks. Four men, shoveling all the time into the unloaders, were able to keep the truck and trailer moving without delay.

Tenders and For Sale Department

Tenders Wanted

Tenders will be received by the Council of the Township of Hullett up to 2 p.m. on **Thursday, the 3rd of February, 1916**, for the erection of a steel bridge over the Walkerburn Creek, five miles north of Londesboro, the said bridge to be 60 ft. long and 16 ft. roadway, with cement floor and to be built on cement abutments. The lowest or any tender not necessarily accepted.

3-4 JAMES CAMPBELL, Clerk.

Tenders for Extension of Cold Storage Division—Civic Abattoir

Tenders addressed to the undersigned will be received by registered post only up to 12 o'clock noon on **Tuesday, February 1st, 1916**, covering the extension of cold storage division at the City Abattoir.

Specification may be seen and tender form obtained, together with all information relative thereto, at the Office of the Department of Property, City Hall, or upon application to Mr. D. W. Wright, Manager of the Civic Abattoir, Tecumseh Street.

The usual conditions pertaining to tendering, as prescribed by the City By-law, must be strictly complied with, and envelopes containing tenders must be plainly marked on outside as to contents. A bond from a Guarantee Company, satisfactory to the City Treasurer, will be accepted in lieu of the personal sureties provided for in the specifications. The lowest or any tender not necessarily accepted.

T. L. CHURCH, (Mayor),
Chairman of Board of Control.
City Hall, Toronto, January 12, 1916. 3

Board of Education

Sealed tenders, addressed to the Secretary-Treasurer of the Board, will be received until

Friday, January 28th, 1916
for

Drawing Tables and Side Arm Chairs for Malvern Avenue High School

Ash Hoists, Electric Wiring, Fire Doors, Steam Fittings, at Sundry Schools

Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto. Each tender must be accompanied with an accepted bank cheque for five per cent. of the amount of tender or its equivalent in cash, applying to said tender only. Sureties for all tenders exceeding four thousand dollars must be furnished by Surety Companies. Tenders must be in the hands of the Secretary-Treasurer at his office in the City Hall, not later than 4 o'clock on the day named, after which no tender will be received. The lowest or any tender will not necessarily be accepted.

W. C. WILKINSON,
Secretary-Treasurer.
MILES VOKES,
Chairman of Committee.

Tenders Wanted

Sealed tenders will be received by the undersigned, addressed to Chester S. Walters, Esquire, Mayor, Chairman Board of Control, up to 5 o'clock p.m., **Monday, the seventh day of February, 1916**, for supplying mechanical rakes and appurtenances and travelling hoist and grab bucket (one-half cu. yd. capacity) and appurtenances for Gage Avenue pumping station.

Tenders to be on forms supplied by the City Corporation and plainly marked on the outside as to contents.

Plans, specifications, and further details can be obtained upon application to the City Engineer's office, Hamilton, Ont., Canada.

The lowest or any tender not necessarily accepted.

S. H. KENT,
City Clerk.
Hamilton, Jan. 14, 1916. 3

School Tenders

Tenders for all trades in connection with the erection of addition to St. Joseph's, St. Clare's, and St. Anthony's Separate Schools and new school for St. Monica's Parish, for the Separate School Board for the City of Toronto, will be received until 5 p.m., **Wednesday, January 26, 1916**, at the office of the Board, 67 Bond Street.

Tenders to be submitted on forms supplied and to be addressed to E. F. Henderson, Chairman of Sites and Buildings Committee, and to be accompanied by a marked cheque for 10 per cent. of the amount of tender.

Plans and specifications may be seen at the office of the Architect, Charles J. Read, Rooms 203-4 Confederation Life Building, Toronto.

52-2-3

Concrete Mixers

Large company in Middle States making concrete mixers wants selling agents for Canadian territory. Good working arrangement and substantial assistance will be given to reliable aggressive agents. Box 279, Contract Record, Toronto, Ont. 1-4

Quarry Machinery Wanted

Two gang saws and one planer in good working order.

F. ROGERS & COMPANY,
1193 Queen Street West,
1-2-3 Toronto, Ont.

Contractor's Plant For Sale

Two Ransom, 10 cubic feet capacity, Concrete Mixers, one equipped with loading skip, complete with steam engine.

One Beatty Hoisting Engine, single drum, double cylinder, 14 h.p., A1 condition.

One American Single Drum Hoisting Engine, single cylinder, 16 h.p.

Ten concrete carts, tools, etc.

Will dispose of at sacrifice price, and make terms of payment to suit purchaser. Apply Mr. Creed, Room 903, Read Building, Montreal. 3-4

Hoist Engine Wanted

8 x 10 or 7 x 12 Double Hoist, Double Drum, each Drum equipped with Ratchet and Pall and Brake Straps, with swinger attached, Boiler to have working capacity not less than 100 lb. steam pressure.

The whole machine to be in first class working order. Address,

MacFarlane-Pratt-Hanley, Limited,
3-3 Port Robinson, Ont.

Late News Items

Arnprior, Ont.
The Department of Militia & Defence, Ottawa, have let the general contract for the erection of a drill hall to Maurice Sullivan, Harriett Street.

Barrie, Ont.
A by-law has been carried authorizing roadway construction on Bradford St., estimated to cost $7,500. Town Clerk, E. Donnell.

Birchcliffe, Ont.
Fire has completely destroyed St. Nicholas Anglican Church. Loss, $5,000. Pastor, Rev. C. E. Luce.

Buckingham, Que.
The Alexandra Hotel, which was recently destroyed by fire, will be rebuilt immediately. Stone and brick construction. Estimated cost, $20,000. Owner, J. A. Bernardin.

Halifax, N.S.
The Young Street School has been completely destroyed by fire. Loss, $60,000. Chairman of the Board of Education, A. I. Macdougall.

Hamilton, Ont.
Tenders will be received until 5 p.m., February 7th, by the Board of Control, for the supply of mechanical rakes, travelling hoist and one-half cubic yard grab bucket. Plans and specifications at office of the City Engineer.

In connection with the factory which is being built on Sherman Avenue for the Canadian Cartridge Company, 161 Oak Avenue, the contract for steel work has been let to the Hamilton Bridge Works, Bay Street N., and for roofing to T. Irwin & Son, 22 McNab Street.

Montreal, Que.
The contract for plastering required in connection with the hotel now being erected for T. Bastien, 5 Beaver Hall Square, has been awarded to Joseph Chamberland, 553 Durocher Street.

Port Arthur, Ont.
Fire has destroyed the Walsh Block, Arthur Street. Loss, about $150,000. Occupants, Dominion Bank, Shields Grocery, Wright & Hepburn, furntiure dealers, G. Morris, undertaker, Hodgin's Cigar Store.

Sydney, N.S.
The Knights of Columbus contemplate the erection of a building on the Esplanade, to cost about between $20,000 and $30,000.

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Vol. 30 **January 26, 1916** **No. 4**

Principal Contents

After All, is Sir Robert the Leader?

Do we understand from Sir Robert Borden's attitude in the House that he refuses to hold an investigation into the charges that have been made in connection with the letting of Canadian munition contracts?

If he knows that the charges are false, would one not expect he would jump at the chance of clearing the reputation of his friends? What is the inference if he refuses?

If he persists in sidestepping the issue we believe Sir Robert has missed the chance of a lifetime to show himself a really big man. Will he prove to be what men are saying of him to-day, or will he measure up to the standard of his opportunities?

The Attorney General seeks to draw a herring across the trail in placing responsibility on the British Government. That's not the issue. The Canadian people want to know whether the men holding executive positions have conducted themselves as becomes appointees of a party holding a great public trust, in accord with the honor of citizens of our great Empire and in the best interests of the efficient conduct of our war.

The original Shell Committee undoubtedly deserves credit for the despatch with which they placed orders among manufacturers, who were naturally shy of accepting the responsibilities of big and uncertain capital expenditures. But what conceivable excuse is there for refusing these same manufacturers further orders—even to the extent of turning down an offer to furnish at cost?

Before the public press became aware of the existing conditions, rumors of what was transpiring reached this paper, and we felt it was our duty to bring certain matters to the attention of our readers. Under the caption "In the Public Eye" we have touched upon, possibly, no more than ten per cent. of the information that has reached us, much of which at the present time is unprintable. It has been our endeavor to cover only such points as would further the common cause, and interfere as little as possible with our national military operations.

As we expected, even in this we have found the path of the pioneer proverbially unpaved. We have the satisfaction, however, of having started a protest that is now being taken up by the independent press even of the Conservative party, and that is ringing from coast to coast among our citizens of influence and power who love honor and efficiency more than money or party. We have the satisfaction of hundreds of friendly assurances that our course has been right, and believe we are backed by thousands more who have read and silently approve our stand.

And now, let us get along with our share in this big war. We have placed ourselves on record, and for the present will let matters rest there. No matter how badly we are led, Canada is in it to our last man, our last dollar, and to our last shirt.

Town Planning Act

The Montreal Chambre de Commerce has passed a resolution asking the Provincial Government to pass a town-planning act, which would allow Quebec cities to take in such adjacent territory and make such arrangement of the territory within the boarders as would allow its development aesthetically and commercially in the most convenient and harmonious manner. The best sanitary conditions, the nearest complete facilities possible for transportation, well-designed arrangements to further the work of the manufacturer and the business man, and sanitary, pleasant dwellings for the citizens were among the details of the plan which the Chambre thought should be included in the powers given in such a law in order that each city should be able to make the most judicious use possible of the territory at its disposal.

Comparative figures of our three chief railways for the first two weeks of the present year and the first two weeks of 1915 show the following very remarkable increases:—

	1916	1915
Can. Pacific Railway	$3,737,000	$2,637,000
Grand Trunk Railway	1,847,003	1,533,267
Can. Northern Railway	1,010,400	665,000

Quebec Association of Architects

In the absence of Mr. J. Perrault, president, who is abroad, Mr. Hugh Vallance took the chair at the annual meeting of the Province of Quebec Association of Architects, held on January 15 at Quebec. The report of Mr. J. Emile Vanier, the secretary, pointed out that the year had been devoid of special interest, on account of the war, and that the lack of new buildings had adversely affected the profession. In Quebec, however, the annual report of the Quebec section stated, the depression had not been felt to any extent. The Association had lost three members by death—Mr. R. P. Lemay, Mr. David Ouelett, and Mr. A. I. Richardson, the last-named being killed at Langemarcke, and the Association passed a special vote of condolence with Mr. Richardson's family. On motion of Mr. J. Lebon, seconded by Mr. J. P. Ouellet, it was decided to write the Department of Public Works, Ottawa, asking that members of the Association be employed on Government buildings in the province of Quebec and that the legal fees be paid. It was also decided that the Association should not apply to the Quebec Legislature for charter amendments. The usual banquet was not held owing to the war, and the members further decided not to celebrate the twenty-fifth year of the Association's existence. The following officers were elected: president, Mr. E. B. Staveley, Quebec; first vice-president, Mr. Hugh Vallance, Montreal; second vice-president, Mr. G. A. Monette, Montreal; treasurer, Mr. N. MacVicar, Montreal; secretary, Mr. J. Emile Vanier, Montreal; council, Messrs. M. Eug. Payettte, Frank Peden, Alph. Piche, H. J. Asselin, J. Lebon; delegates to the Royal Architectural Institute of Canada, Messrs. Joseph Perrault, Alcide Chausse, D. R. Brown, Jos. P. Ouellet, A. Beaugreand-Champagne.

Department of Public Highways

It is now formally announced by the Ontario Government that a separate Department of Public Highways has been created. The new department will be in charge of a Deputy Minister, to which position Mr. W. A. McLean, Provincial Engineer of Highways, steps up. Hon. Finlay Macdiarmid will in future be known as the Minister of Public Works and Highways. This latest move on the part of the Ontario Government indicates their intention of prosecuting vigorously the development of highways at various points in the province. Provision is made for the construction of suburban and township roads in addition to county roads. An efficient system of maintenance of roadways will also be inaugurated.

The province is to be congratulated in that an appointee with the personality, ability, and experience of Mr. W. A. McLean was available for this position. Under his guidance we have no doubt that the highways of the province of Ontario will be rapidly improved and maintained in the most efficient and economical manner.

Honored the New Knight

Sir John Kennedy, the consulting engineer of the Montreal Harbor Commission, was, on Saturday, January 15, entertained at dinner by the staff of the Harbor Board to celebrate the honor of knighthood conferred on their colleague. Major David Seath, the secretary, presided, and referred to the long service of Sir John, and to the important works with which he has been identified, including the development of the port of Montreal. Notwithstanding Sir John's blindness in later years, he has designed many works, one being the fine piers at Halifax for the Department of Railways and Canals. Replying to the toast of his health, proposed by Mr. F. Robertson, Sir John acknowledged the congratulations which he had received, and said that the work done during his thirty-three years with the Harbor Commission was not as prominent in his mind as the men who had worked with him in securing that development. The health of the engineering department was replied to by Mr. F. W. Cowie, chief engineer.

Annual Meeting C.S.C.E.

The annual meeting of the Toronto Branch of the Canadian Society of Civil Engineers, at which the report of the retiring secretary was presented, shows that the Branch is in a healthy condition, both as to finances and membership. The figures indicate that the Toronto membership is now 344, or an increase of 49 over the year 1914. During the year valuable contributions to the literature of the Society were made in some half dozen addresses by prominent Canadian engineers, including Mr. W. McNab, Mr. T. T. Black, Dr. J. A. Amyot, Mr. H. S. Van Scoyoc, and Mr. J. A. D. McCurdy. The annual excursion of the Branch consisted of an inspection tour of the construction work of the new Welland Ship Canal. Various reports were presented by the different committees which had been appointed earlier in the year for this purpose, and these reports were forwarded to Montreal for incorporation in the general report to be presented at the annual meeting of the Canadian Society of Civil Engineers in Montreal on January 25, 26 and 27.

The following officers were elected for the coming year: president, Mr. G. A. McCarthy, engineer of Railways and Bridges of the city of Toronto; secretary-treasurer, Prof. Arkley, Department of Applied Science and Engineering of the University of Toronto. Executive committee: Messrs. E. W. Oliver, assistant engineer, C. N. R.; A. H. Harkness, consulting engineer; A. L. Mudge, consulting engineer; and H. G. Acres, hydraulic engineer, Hydro-Electric Power Commission of Ontario. During the past year the Toronto branch of this society has shown very effective evidence of a determination to make the operations of this branch an essential part of the proceedings of the parent society.

At a meeting of the Quebec Superior Board of Health, held in Montreal on January 14, it was decided to ask the Government to increase the grant of $35,000 to supervise the execution of the Health Act in the province. The members suggested an increase from 1¾ cents per head of the population to 2½ cents, which is lower than is paid in other provinces. The board approved a committee's report on the restrictions that should be made to the use of chlorine for the correction of water supplies. Chlorination cannot fill the place of filtration; as it is quickly set up, it is of great help in an emergency until a permanent filter plant can be provided. On the report by the sanitary engineer that the water supplies of the cities of Hull and Aylmer were polluted, the board ordered the secretary to serve a notice on the authorities of both cities to appear before the board, municipalities having to be heard before remedial measures can be considered by the board.

The City of Montreal Filtration Works

The necessity of a better quality of domestic supply recognized by the increasing death rate—Features of the new works described—Constructional difficulties—Cost figures

By Frederick E. Field*

The water used by the citizens of Montreal is obtained from the St. Lawrence River and is distributed to the consumers by two entirely independent corporations. The Montreal Water and Power Company, a private corporation, has a shore intake and has purified its water supply since June, 1912, by means of a mechanical filtration plant. This company supplies approximately 27 million gallons daily to about 250,000 people, including many residents of adjoining municipalities. The municipal plant of the city of Montreal has both a shore and a mid-stream intake, situated about two miles above the Lachine Rapids of the St. Lawrence River. From an entrance gate chamber which receives the supply from both intakes, a concrete conduit 8½ feet in diameter, conveys the water to the Low Level Pumping Station, from which it is pumped through the distributing mains to the city's reservoirs. This station supplies between 50 and 55 million gallons daily to approximately 400,000 people.

Need of Purification

For many years the excessive number of cases and deaths from typhoid fever has shown the necessity of improving the quality of the water used for domestic purposes.

The increasing pollution of the water supply, due to the discharge of sewage and other impurities from towns within the drainage area above the intake is indicated by Fig. No. 1, which shows graphically the total number of deaths and the death rate, per 100,000 population, from typhoid fever for a long period of years. During the late fall and winter of 1909-1910, a severe epidemic of typhoid fever prevailed in Montreal and its suburbs, and occasioned 203 deaths between October 1st, 1909, and March 1st, 1910. The necessity for prompt action was recognized by the city officials, and on February 8th, 1910, the treatment of the municipal water supply by hypochlorite of lime was started, and has been regularly continued to the present time. On April 4th, 1910, Messrs. Hering and Fuller, filtration engineers, were instructed to report on the best means of securing an improved water supply for the city. On July 2nd, 1910, these engineers submitted their report and recommended filtration of the St. Lawrence River water. Their recommendation was adopted by the city and Messrs. Hering and Fuller were engaged to co-operate with the late Major Georges Janin, then chief engineer, in preparing plans and specifications and in supervising the construction of filtration works for the city of Montreal.

General Description

The filtration works, which are now practically completed, with the exception of the placing of the filtering material, are designed for a nominal daily capacity of fifty million Imperial gallons.

A nine-foot concrete conduit connected to the 8½-foot main supply conduit, previously mentioned as supplying the low level pumping station, will bring the untreated St. Lawrence River water to what is known as the Filtration Pumping Station. A five-foot branch from this nine-foot conduit, permits of a second source of supply to the filtration works, namely from the Aqueduct. This five-foot, or emergency, intake will only be used when the main supply conduit is not in service or when its capacity is not alone sufficient for the daily use of water by the city, as the aqueduct water is more highly polluted than water obtained from the mid-stream intake of the St. Lawrence River. The purpose of the filtration pumping station is to lift the conduit or aqueduct water to the prefilters, a height of approximately 18 feet, and to furnish water at a higher pressure for washing the prefilters at times of cleaning. From the prefilters, or rapid-filters, which is the first step in the purification process, the water will flow by gravity to the final filters, which are quite similar in construction to the usual slow sand filters.

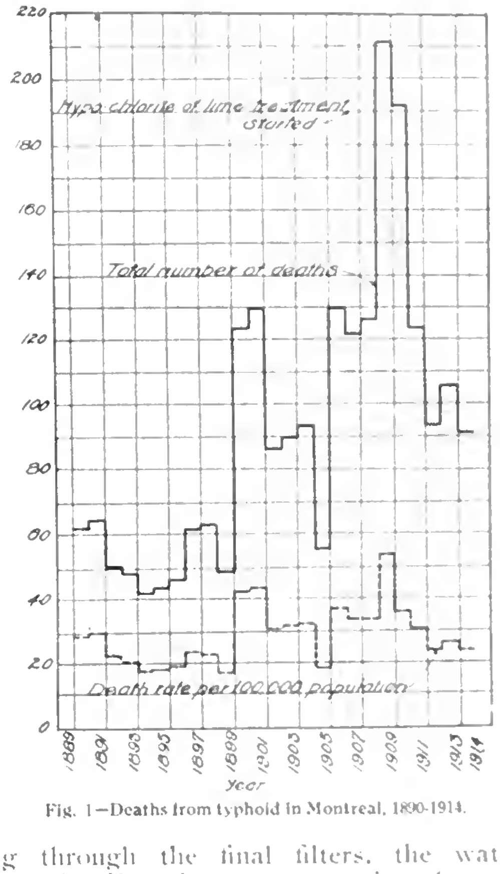


Fig. 1—Deaths from typhoid in Montreal, 1890-1914.

Passing through the final filters, the water will flow into the filtered water reservoir, where, if it is deemed desirable, it will receive a final purification by treatment with hypochlorite of lime. No chemical treatment of the water will be made prior to its reaching the filtered water reservoir and such treatment at this point may not be found necessary during certain periods of the year.

From the filtered water reservoir the purified water will again flow to the filtration pumping station, from which it will be pumped to the present low level pumping station, where it will be forced by high pressure pumps through the distributing mains and to the

*Resident Engineer.

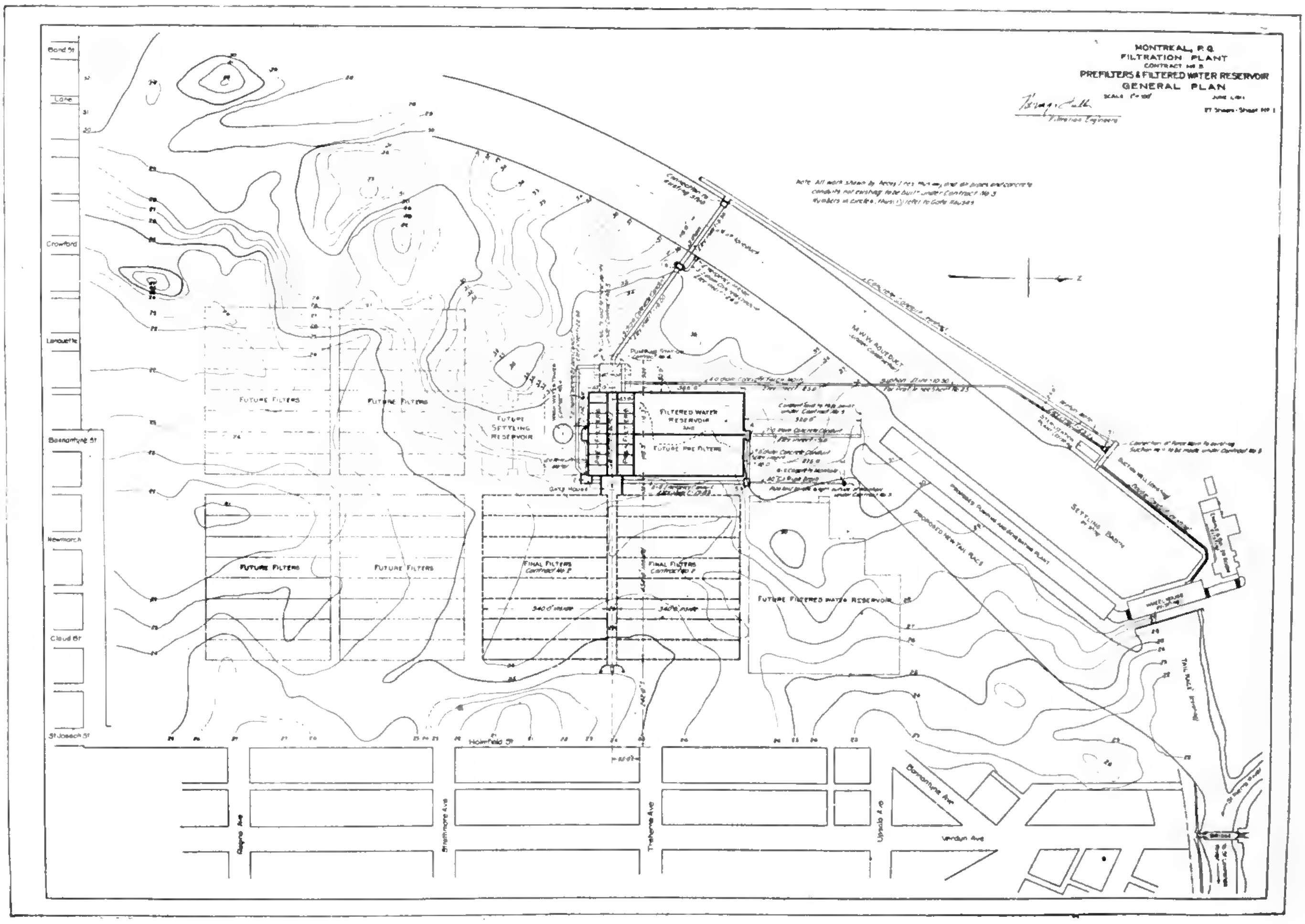


Fig. 2—General Arrangement of Filtration Works, Montreal.

reservoirs. After the completion of the aqueduct enlargement work, which is now under construction, the filtered water will not return to the filtration pumping station but instead will flow by gravity from the filtered water reservoir to the new hydro-electric pumping station at the end of the aqueduct, and from this point will be delivered through the distributing mains to the consumers. Fig. 2 shows the general arrangement of the filtration works and its relation to the aqueduct and pumping station.

Filtration Pumping Station

The filtration pumping station, Fig. 3, is a two-storey structure about 80 ft. x 60 ft. in size. The lower storey is below the ground level, and is traversed by the raw-water suction conduit and the raw-water discharge conduit, which are placed one upon the other. The direct connected motor driven, centrifugal pumps are arranged on either side of the central conduits in such manner as to obtain their supply from the lower, or suction conduit and deliver into the upper or discharge conduit with a minimum of piping connections. Four of the pumps on the north side of the station are also similarly connected to a filtered water suction conduit and a filtered-water discharge conduit, and provided with suitable check and controlling valves. This will permit of one or all of these pumps on the north side of the station to be used for delivering filtered water to the present low level steam pumping station until such time as the new hydro-electric pumping station is completed, after which, as previously stated, the filtered water will flow by gravity to the new pumping station, and all raw-water pumps in the filtration pumping station will be available for supplying the filters.

The pumping station includes the following units:

4 raw water pumps,	unit capacity	17,500 Imp. gal. per min.
2 raw water pumps,	unit capacity	11,600 Imp. gal. per min.
2 raw water pumps,	unit capacity	5,800 Imp. gal. per min.
2 wash water pumps,	unit capacity	1,300 Imp. gal. per min.
1 sump water pump,	unit capacity	330 Imp. gal. per min.
1 sump water pump,	unit capacity	150 Imp. gal. per min.
1 rotary blower,	unit capacity	5,000 cu. ft. air per min.

Switchboards, transformers, cranes and other equip-

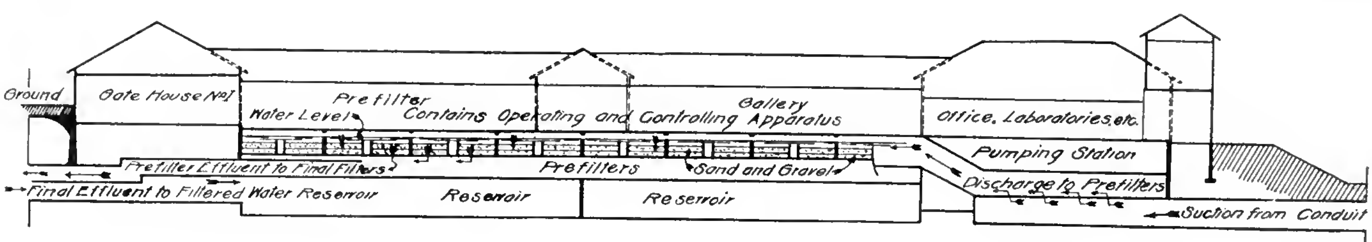


Fig. 3—Section of the Filtration Pumping Station and Prefilters—showing course taken by water.

ment are provided to make the installation complete. The wash water pumps and the blower are for use in seepage and drainage water. The six largest pumps and the blower are operated by motors using 2200 cleaning the pre-filters. The sump pumps will remove volt alternating current. The other pumps operate under 550 volt current. The upper storey of the pumping station is above the ground level and, similar to all other buildings of the works, has walls of red brick and cinder concrete roofs covered with green tiles. The north side of this upper storey contains a laboratory for water analysis and other purposes usual in the operation of filtration works. The south side contains rooms for storage and other needs. Fig. 4 shows a section of the pumping station.

Pre-filters

The pre-filters, located east of and adjoining the pumping station, are supported by groined arches above the roof of the filtered-water reservoir. They are sixteen in number, each having a net filtering area of 1,200 square feet, and are arranged eight on each side of a central operating gallery. Each prefilter is divided longitudinally by a central gutter into which empty the sixteen laterial reinforced concrete wash-water gutters. The strainer and air system is made up of cast iron headers and 2-inch cast iron laterals, with brass strainers spaced on 6-inch centers. The filtering material consists of 15 inches of gravel, graded into four sizes and placed in corresponding layers, and 30 inches of filter sand. The details of a prefilter unit is shown in Fig. No. 5.

Longitudinally through the centre of the operating gallery are two concrete conduits, placed one upon the other. The upper one is the raw-water supply conduit from the filtration pumping station and the lower is the prefilter effluent conduit leading to the final filters. These two conduits are connected to the prefilters by cast-iron piping with hydraulic controlling valves. All these valves and also the valves for wash water, air, and drainage are controlled from sixteen operating tables on the gallery floor, one operating table being located in front of its corresponding filter. For controlling the rate of filtration, rate controllers of the Earl type are provided. These are so connected to a master controller that the discharge from the prefilters is automatically adjusted to the discharge from the final filters, which in turn is similarly automatically controlled by the amount of water being drawn from the filtered water reservoir. In other words, the plant as a whole will deliver filtered water at the same rate as it is being used in the city without man operation of the many controlling valves. All other features of the prefilters are of the usual construction and need no detailed description. Fig. No. 6 shows the completed prefilter gallery.

Final Filters

The final filters are sixteen in number, and, similarly to the prefilters, are arranged eight on each side of the operating gallery. The filters are covered by groined arches supported by piers spaced on 19 feet centers. The pier load is carried on foundation blocks independent of the rest of the floor, which is flat, and but five inches thick. The filters are each 55 x 340 feet, inside measurements, with the short dimension

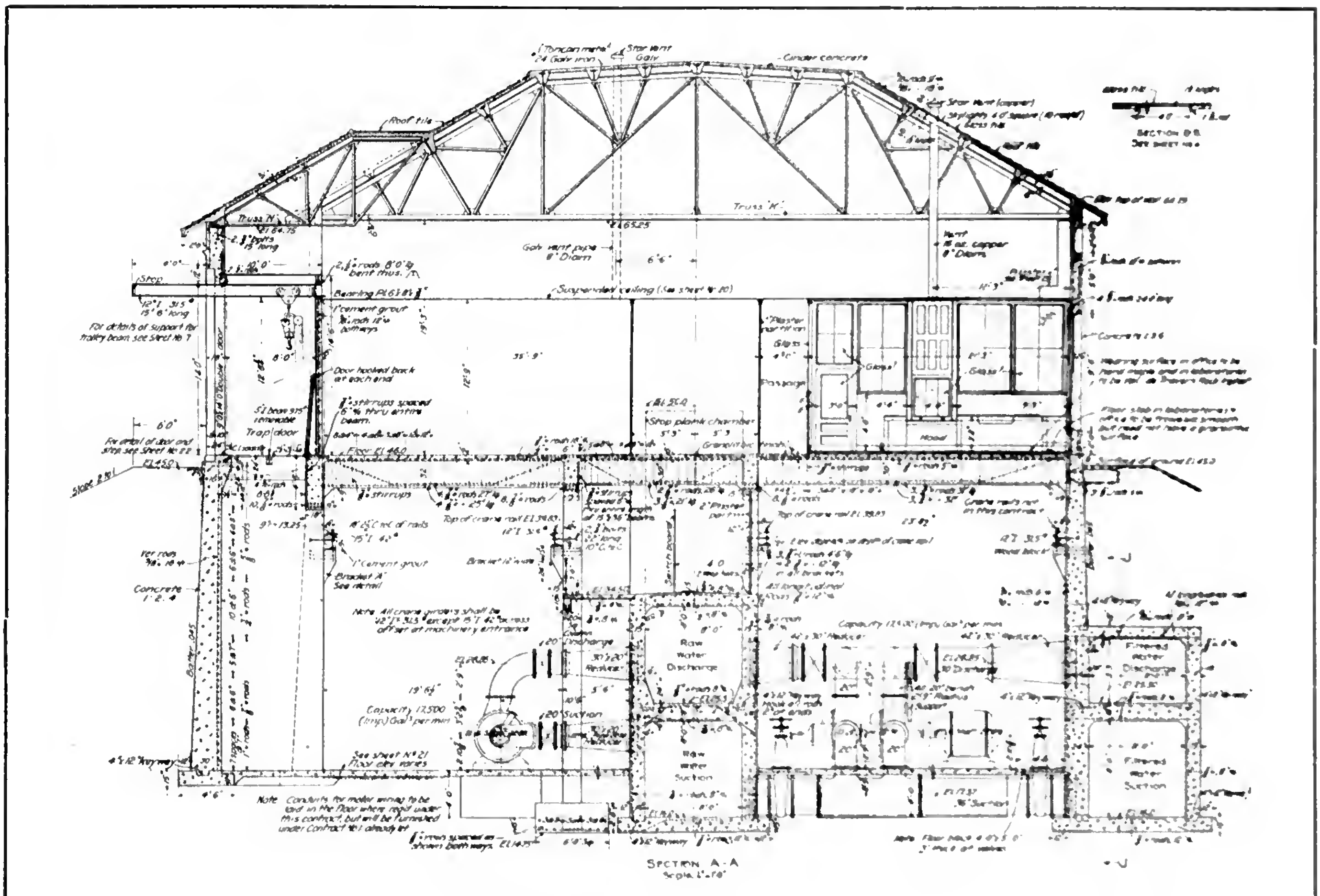


Fig. 4 Section of Filtration Pumping Station.

adjoining the gallery to better accommodate the use of Blaisdell washing machines for the filter cleaning. The underdrainage system consists of two half round 8-inch tile laterals in each bay, which discharge into a central main collector, 2½ feet in diameter, extending the entire length of the filter below the floor level.

A heating and ventilating system is provided to prevent skin ice forming during the winter months and interfering with the free movements of the washing machines, and also to make the filters more healthful and comfortable for the workmen. This consists of a fan and a system of air ducts so arranged that

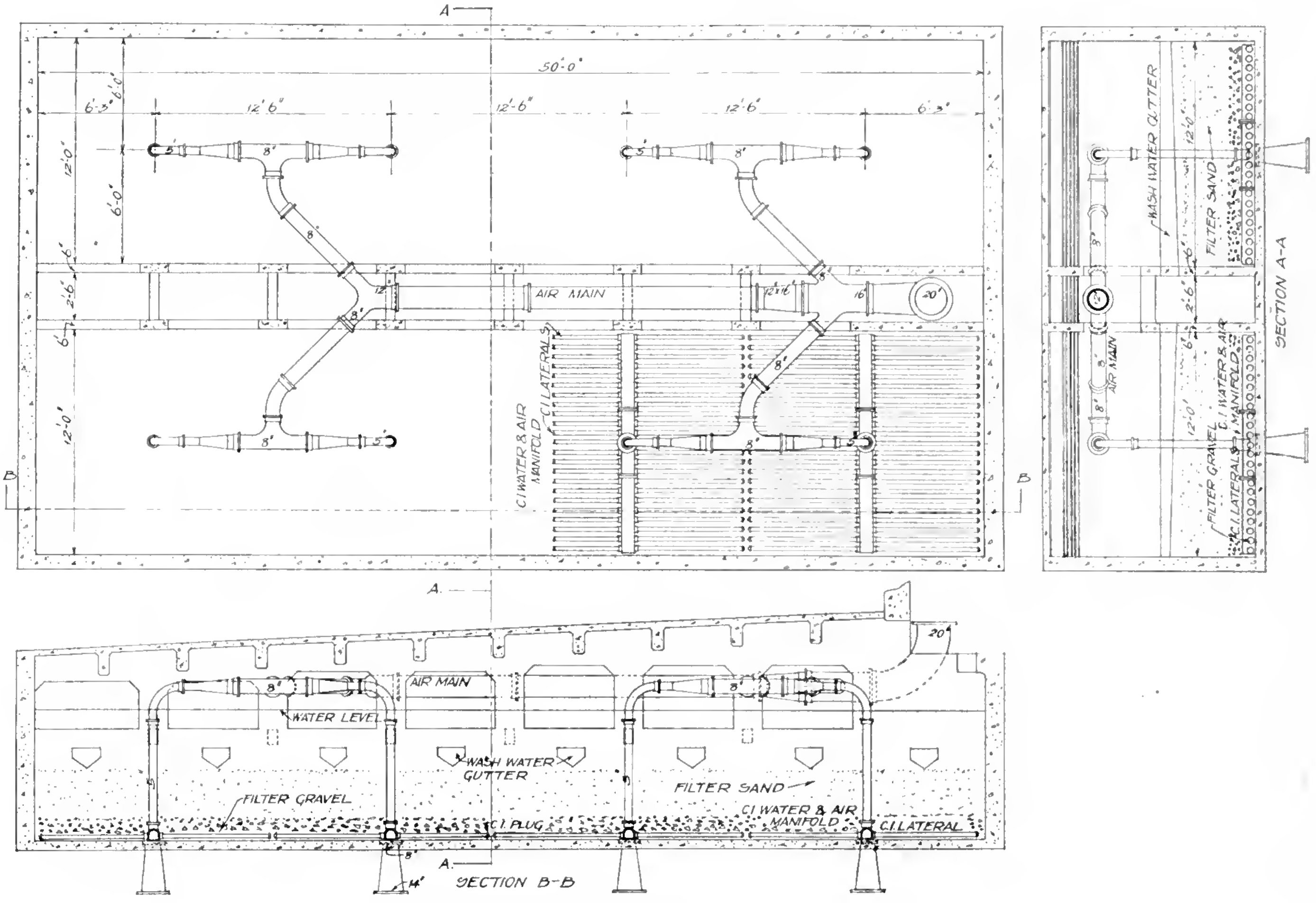


Fig. 5—Details of the Prefilters—Montreal Filtration Plant.

The filter material includes 12 inches of graded gravel, placed in four layers, and 27 inches of sand. The conduits and piping connections in the gallery, including the Earl rate controllers, are similar to those of the prefilters. The periodical cleaning of the final filters will be accomplished by Blaisdell washing machines. These machines, travelling on tracks supported by the piers, will rake and wash the upper layers of the sand, leave the sand bed clean and uniform, and pump away to the drains all dirt and other foreign matters which have accumulated since the previous washing. All this will be accomplished at one operation and by one man operating the machine.

Among the advantages of this method of cleaning the filters are:—

(1) The length of time the filter is out of service is a minimum.

(2) The removal of the dirt from the sand is more complete than can be done by hand cleaning as the cleaning process extends to any desired depth below the surface of the sand.

(3) The sand bed is left more uniform and without the compacting which accompanies the walking over the sand by workmen.

(4) There is no break in the regular routine of the work during the winter months and no decrease in the effective filtering areas.

heated air can be blown uniformly over the entire area of the filters. Fig. No. 7 shows the details of design of the final filters, and Fig. No. 8 is an interior view of the completed final filter gallery.

Filtered Water Reservoir

The filtered water reservoir is of concrete with groined arches for the roof and inverted groined arches for the floor. It is about 430 x 232 feet in size and has a capacity of 6¼ million Imperial gallons. With the exception of its use to control the output of the plant, as has previously been described, there is nothing unusual in its design or method of operation.

Electrical System

The Montreal filtration works uses electric current for power, heating and lighting. Until the completion of its own hydro-electric power and pumping station, the city will obtain electric current from the Montreal Light, Heat and Power Company, which has a 10,000 volt transmission line near the works. Branch connections from this transmission line will bring 10,000 volt alternating current to the filtration transformer building, where it will be reduced to 2,200 volts and transmitted through an underground conduit system to the filtration buildings. Here it will be used at the same voltage for the motors operating the main pumps or reduced to 550 and 220 volts for other mach-

Fig. 6—Completed Prefilter Gallery.

inery and for lighting and heating. Heating throughout the entire works will be accomplished by electric radiators. The Blaisdell washing machines use direct current, consequently a motor generator set is provided to supply this current to the machine motors through the three miles of double trolley lines by which the machines are operated in the final filters.

Exterior Appearance of Completed Work

In the centre of a level tract of land nearly 100 acres in extent, mounds of earth with neatly trimmed slopes, and several red brick buildings with green tile roofs give but little indication of the extent of the many and interesting features of the filtration works there located. Of the ten acres covered by the present works, over nine acres, including the final filters, prefilters and filtered water reservoir are entirely underground. The pumping station, prefilter gallery building, wash water tower and the several gate houses, serve to identify the several divisions of the works. It only requires the extension of driveways and the planting of trees and shrubs to convert the filtration lot into a spacious park which will not only be appreciated by the nearby residents, but will also give the city of Montreal an attractive setting to one of its most beneficial public works. The approximate cost of the work is given in the following tabulation:

Delays in Construction

Contracts Nos. 1, 2 and 3 were awarded in the late summer and fall of 1911, and when the work under these contracts was sufficiently advanced, the other contracts were awarded in logical order. Very little work was accomplished in the final filters, prefilters and filtered water during 1911, and it was not until July, 1912, that the first contract was placed. The progress during 1912 was also slow and unsatisfactory, due to unwise selection of plant and organization by the contractor on contracts Nos. 2 and 3. During the winter of 1912-1913, failure on the part of the contractor to protect the floors and foundations of the final filters against damage by frost action, resulted in a general upheaval of the foundation of the walls and piers, the cracking and lifting of the filter floors, the collapse of many of the main collectors and miscellaneous other damage. Much of the spring and early summer of 1913 was occupied in an investigation of this damage and resulted in the contractor acknowledging his responsibility therefor. The troubles on contracts 2 and 3 seriously delayed the work on the other contracts, and September 1st, 1913, the date specified for final completion of all the contracts, found the filtration works in a sad state of incompleteness. During 1914 and 1915 the work progressed at a slow and unsteady rate on contracts 2 and 3, due largely to organization and financial

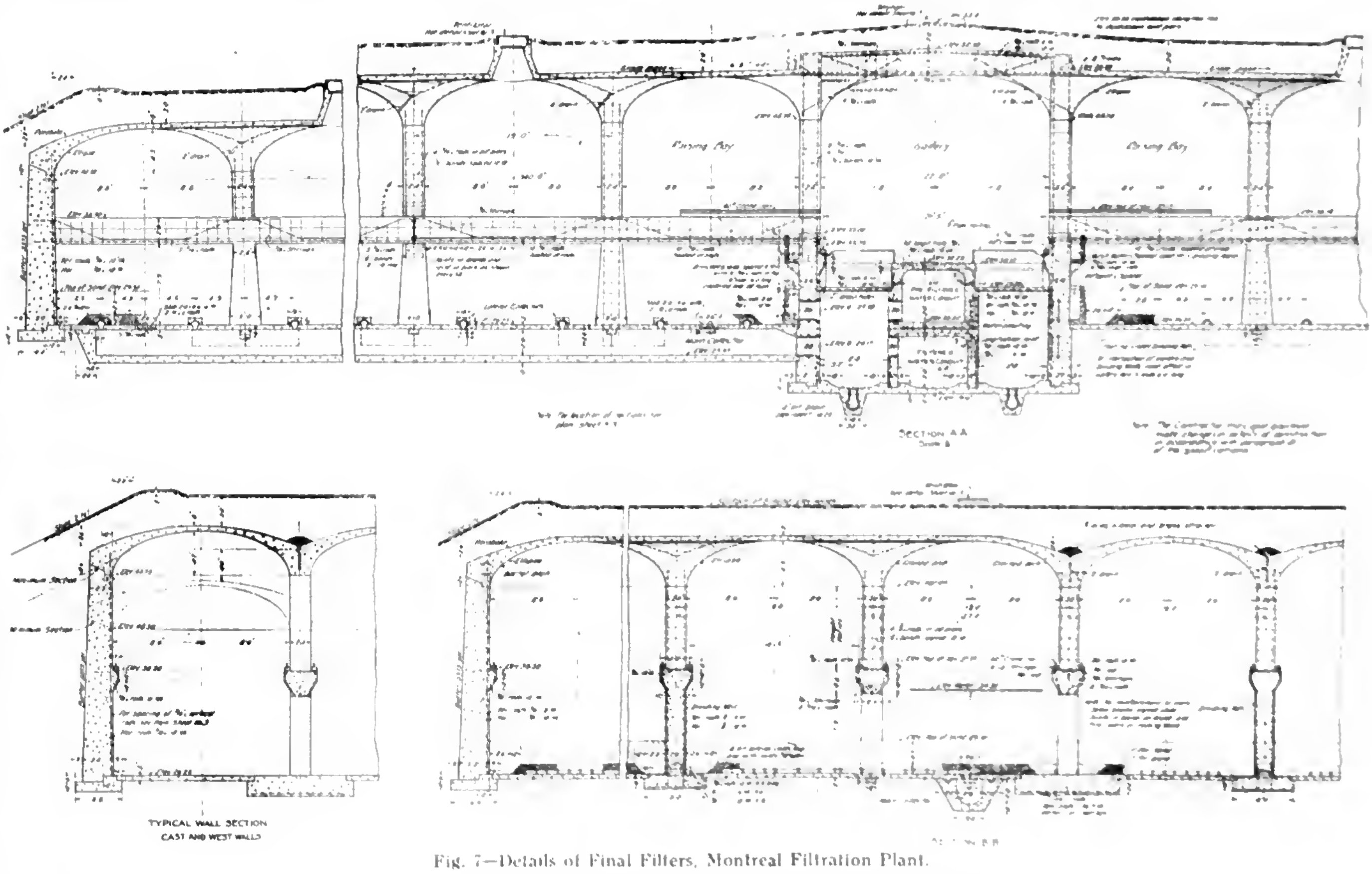


Fig. 7—Details of Final Filters, Montreal Filtration Plant.

Table I.—Filtration Contracts

No.	Description	Contractor	Value
1.	Pumping machinery, blower and cranes	British Electric Plant Company	40,250
2.	Final filters and appurtenances	F. H. McGuigan, transferred to Norman M. McLeod	673,000
3.	Pre-filters and filtered water reservoir	F. H. McGuigan, transferred to Norman M. McLeod	485,000
4.	Pumping Station, wash water tower and buildings	F. J. Jago Company, Limited	159,500
4a.	Interior painting	Charles Larin	1,250
5.	Exterior electrical conduit system	G. M. Gest	6,000
5a.	Underground electrical cables and appurtenances	Northern Electric Company, Limited	12,500
6.	Transformer building	City of Montreal	6,000
		Approximate total value	$1,383,500

troubles. The progress on all other contracts has been quite satisfactory considering the many impediments to rapid completion. On January 1st, 1916, all work is so far completed that the operation of the plant is only prevented by the lack of filter sand and gravel. It is expected that this very important item of the work will be rushed to rapid completion during the coming season and that before the end of the year 1916, the citizens of Montreal will at last realize their long felt need, namely, a pure and wholesome water supply.

Need of Extensions to Filtration Works

In 1910, when the design of the filtration works was started, the amount of water supplied by the municipal waterworks was about 37 million Imperial gallons per day. The filtration works were designed for a nominal daily capacity of 50 million gallons, which was one and one-third times the daily water use in 1910. It was realized at the time that extensions to the filters would be required in a few years, and provisions in the designs of the works now constructed allow for extensions with but little difficulty and without serious disturbance in the regular operation of the plant. Annexations of adjoining municipalities and the large extensions of the city's water distribution system have, however, been much more rapid than was expected. From 1910 to 1915 the water used has increased from 37 to 55 million gallons per day, and the filtration works now nearing completion will be required to work at full capacity from the day it is put into service.

Fig. 8 - Final Filter Gallery.

The need for immediate action to provide for a daily capacity of 100 million gallons of filtered water is so apparent that the city will undoubtedly, in the near future, let contracts for the extension of the present filtration works.

The filtration works and other waterworks improvements are being carried out under the general supervision of Messrs. Paul E. Mercier, Chief Engineer of Public Works, and T. W. Lesage, Engineer Superintendent of Water Works.

Toronto Builders' Exchange

At the annual meeting of the Toronto Builders' Exchange, held on January 17th, the following officers were elected:—President, S. R. Hughes; first vice-president, W. E. Dillon; second vice-president, Walter Davidson; treasurer, John Aldridge. Elected Directors: Fred Armstrong, Ed. Gearing, Geo. Gander, Chas. Bulley, A. D. Grant and five directors still to be appointed. Mr. Geo. Oakley, the retiring president, stated in his report that the new form of contract upon which the Exchange had been working for the past two years, had been adopted and was now being used by practically every architect throughout the Dominion. Reference was also made to the work of the Exchange in connection with the Workmen's Compensation Act. A motion was adopted requesting members to forward a carbon copy of all reports of accidents, to the Secretary of the Exchange. The financial report showed a good balance. Mr. Arthur E. Flower, Secretary for the past three years, was tendered the hearty thanks of the retiring officers for his efficient work during 1915.

A paper entitled "Studies for and Experiments with Mixtures for Winnipeg Concrete Aqueduct," by W. G. Chace and D. L. McLean was read on January 6th, 1916, before the Manitoba Branch of the Canadian Society of Civil Engineers. This paper dealt with the methods used to ensure water-tight concrete for the Great Winnipeg Water District Aqueduct. It will be presented to the Main Society for publication at a later date.

Construction of City Pavements

Methods employed by different Engineers in laying Stone, Brick, Wood and Bituminous Pavements—The importance of Maintenance and Repairs

By Geo. W. Tillson*

So much has been said in recent years regarding the detailed construction of different pavements that it does not seem necessary to repeat it here. It perhaps would be of more interest and value to discuss somewhat in detail the different points of these pavements concerning which engineers differ. Much could be said regarding the advisability of laying certain pavements on certain streets under certain conditions, but these points are pretty well understood as a general proposition, and there is not much question as to which material should be laid to accomplish certain results.

Stone Pavements

Size of Blocks.—While with different kinds of stone some little variation might be made in the permissible size of blocks, as granite is the kind of stone most generally in use, that will be considered here.

It seems strange, with the many societies for standardizing paving specifications and the close interrelationship of the different engineers making up these societies, that at the present time the different cities belonging to these organizations should not use blocks of the same size. For instance, take the cities of New York, Philadelphia, Boston and Chicago, all of which have had members in these various societies. No two of them specify granite blocks of exactly the same size, and the difference between them is so small that the blocks themselves would not be materially different if any one specification were used. But they vary a quarter of an inch here and a quarter of an inch there, just enough to prevent them being alike, and make it impossible for the quarrymen to manufacture blocks and have them all fulfil the specifications of all the large cities using them. If this difference in size is so small that it does not make any material difference in the blocks themselves, it may be thought that there is no necessity for uniformity; but, as has been intimated, if exactly the same size can be used in the different cities, the granite men can make up blocks during the winter season with the knowledge that no matter if Boston does not use as many as usual during the following season, if New York uses more, there will be just as good sale for them as if the usual amount were used in both cities. In other words, if ten million blocks are to be used in 1916, with the specifications for size the same in the principal cities, it does not make any difference to the manufacturer of the blocks just where they are to be used. This is important to the consumers, as they are often obliged to wait after contracts are let for the delivery of blocks, where, if the stock were on hand, they could be obtained without delay.

If, for instance, the sizes of the blocks could be specified as 3½ to 5½ inches wide, 5 inches deep, and 8 to 10 inches long, allowing proper variations, they would comply with the requirements of the different cities as to service and would be much more satisfactory to the manufacturer, and thus cheapen the price of the blocks.

When the oblong granite blocks were first used they were laid on a sand foundation and a variation of 1 inch allowed in the depth; that is, they were permitted to be anywhere from 7 to 8 inches in depth. When concrete was substituted for sand as a foundation, for many years there was no change made in the depth of the block itself, and it is only quite recently that it has been recognized that, as the actual wear on top of the block is very little, a block 5 inches in depth, or even 4 inches in depth, under certain conditions, would be just as good as a 7-inch or an 8-inch block.

Joint Filling.—The old blocks were laid with a joint of at least ¾ inch and sometimes 1 inch in width. These joints were filled with gravel and the interstices in the gravel filled with paving pitch composed of 100 pounds of coal tar pitch and 20 pounds of asphalt. The result was that the blocks wore off on the edges, becoming round and the pavement rough, before the blocks themselves had suffered any material wear as to depth. With the smaller blocks previously referred to, it is possible to have them so dressed without much extra cost that they can be laid with smaller joints and a more satisfactory filler used. In some cases Portland cement grout has been used for filler; in others, coal tar pitch or some asphaltic compound, and sometimes a mixture of coal tar pitch and sand.

Portland Cement Filler

The Portland cement filler gives a very smooth and satisfactory surface. It allows the blocks to be used somewhat rougher on the sides, as the grout, being so thin, readily runs in and fills up all small spaces. It makes a continuous pavement, both longitudinally and laterally, and if the grouting is well done it probably gives a pavement that will stand more actual wear than that of any other filler. On the other hand it makes an extremely noisy pavement. Noisiness is the most objectionable feature in a granite pavement. The wheels come directly upon the blocks, and, as a vehicle rolls from one end of a street to the other, there is carried along with it a noise and a reverberation that is the accumulation of the noise from the different blocks transmitted through the cement joints to the next blocks, and so on until it is lost in the distance. Also, it is an extremely expensive pavement to tear up for the purpose of making repairs to old or laying new subsurface work. It may be said that this is not an objection to the pavement itself. This is undoubtedly true, but it must be recognized that openings must be made in pavements, and if a pavement cannot be easily and satisfactorily restored after it has been opened, this fact certainly militates against the pavement. It is extremely difficult, especially in a well-travelled street, to repair cuts and keep traffic off the new pavement when it has been repaired with cement grouting until the cement has set.

With a pitch filler the difficulty is to get a material that will not be soft enough to run in summer weather or hard enough to be brittle and crumble in cold weather. A proper combination can and undoubtedly will be worked out to meet this objection, except in most extreme climates. The combination of pitch and sand was probably first used in Liverpool, and this

* Consulting Engineer Borough of Brooklyn, New York City, before Worcester Good Roads Convention.

gives a much tougher mixture than when the pitch is used alone. This combination has been used to some extent in this country, and, in the opinion of the writer, will prove a success.

Cushion.—When the concrete base first came into general use, with the blocks 7 and 8 inches deep, it was necessary to have at least 2 inches of sand on the surface of the concrete as a cushion for the blocks, so that an 8-inch block would have at least 1 inch underneath and the blocks would be firm and have a solid bearing and consequently not have undue pressure from the traffic; but when the smaller blocks are used, with a variation of ¼ inch only in depth, it is not necessary to have so great a depth, and the least amount that will give the block a resilient cushion is all that is desirable. This, with the new blocks, should not be more than ¾ of an inch, or, at the outside, 1 inch in depth.

Practically all stone blocks laid up to the present time have been laid on a sand cushion. There is, however, at the present time a discussion going on to a certain extent in the technical press and among engineers as to the advisability of using a mortar bed for stone blocks. If this be done, the whole pavement, including the foundation, will be practically one piece of masonry construction and extremely solid, so solid in fact that the wear under traffic will be more than if it were resilient. If the pavement itself has a cement filler, and so becomes a monolith, this objection is not so great, but the more solid a stone pavement is the more noisy will it be and the greater its wear.

If a cheap cushion could be made of some resilient material, say a combination of certain bitumens with sand or stone, the writer thinks it would be much more satisfactory than a mortar bed. As has been said, the greatest objection to a granite pavement is its noisiness, and if each individual block can be segregated so that a resilient substance will separate it from every other block or the foundation itself, a pavement the least noisy of all can be obtained. If, for instance, stone blocks could rest on an India rubber cushion with the spaces between the blocks filled with India rubber, the pavement would be resilient, as quiet as possible, and, on account of its resiliency, show the least wear under traffic. While it is undoubtedly impossible to obtain such a condition, it can be approached by filling the joints and the spaces under the blocks with some bituminous material that will have as many as possible of the qualities of India rubber.

Brick Pavements

There is very little difference in the opinions of engineers as regards the construction of brick pavements. All the arguments made regarding the different practices of construction of a stone pavement will apply to a great extent to the brick. There will undoubtedly always be advocates of cement as well as bituminous joints for brick pavements, and recently there has been the same discussion about the cushion as referred to for the stone. The writer feels, however, that the conclusions with regard to stone pavements will hold good as to brick, and believes that a better result will be obtained with the sand cushion than with the mortar bed.

The principal argument against the sand cushion seems to be that it is liable to wash out from under the blocks, thus causing a settlement in the pavement. The writer feels that the chance of this is very small and that it need not be considered.

Wood Pavement

It is here that there is probably more disparity in the ideas and practices of the engineers than in any other kind of pavement. This is true because treated wood block pavement is a complicated structure, and it has been in use a shorter time than the other standard pavements. In the early wood pavements the blocks were untreated, and for that reason it was thought impossible for many years to lay a wood pavement that would be satisfactory. But the treated wood pavements of Europe showed that properly prepared wood was a good paving material, and consequently the industry sprang up in this country.

The first thing so consider is the character of the wood itself. It is generally recognized that long leaf yellow pine is the best material. This, however, is an expensive wood and obtained only in certain sections of the country, and if other woods that are more general in their growth can be used after proper treatment and under certain conditions, the cost of the pavement will be very materially reduced. The Government has been making experiments to determine this, and it is hoped that a satisfactory solution will be reached.

There is very little disagreement regarding the size of the block.s They are generally 3 or 4 inches in width and 3½ to 4 inches deep, and average about 8 inches long.

Treatment of Blocks

The treatment of the blocks, however, is the most important. Blocks have been treated with what is known as the zinc process, and the writer saw some in Brussels, in 1913, being laid on the Waterloo Boulevard that had been treated with sulphate of copper, but to a very slight extent. In this country, and probably in Europe as well, it is generally considered that the best preservative is creosote oil. Creosote oil is now manufactured from both coal tar and water gas tar; the former material has been used to the greatest extent and has given satisfactory results. The proponents of the use of the latter contend that it is as good as the coal tar oil. The experience with the water gas oil, however, at the present time has not been such, in the judgment of most engineers, to make this conclusion positive. Experiments should be carried out to demonstrate the usefulness of the water gas oil, as wherever possible the greatest competition should be allowed to all materials. If the oil from the water gas tar is as good a preservative as that made from the coal gas tar, it should be known and used in open competition with the coal gas tar oil.

Whatever oil is used there is always the question of its character and the amount to be used per cubic foot of wood. As regards the character, the principal difference has been as to the specific gravity. Certain people claim that an oil of a gravity of practically 1.03 should be used, and others an oil of at least 1.08 and preferably 1.10. The advocates of the lighter oil contend that it is less expensive, and that on account of its lower specific gravity it will penetrate more freely into the pores of the wood and thus give a more uniform treatment. The advocates of the heavy oil, however, claim that with proper methods of treatment the blocks can be thoroughly impregnated with the heavy oil and that, because its specific gravity is greater, it will be retained in the block for a much longer period of time and so prolong the life of the block correspondingly.

It must be understood in this connection that the object of the treatment is not only to preserve the blocks from decay but also to increase their stability as to size, so that they will not expand in wet weather, thus causing bulging of the pavement, or shrink in dry weather, thus causing the blocks to become loose. The writer has always believed that the life of a wood pavement in most American cities will depend upon the length of time that the blocks will last without decay; in other words, that it will rot out before it will wear out, and the treatment that will for the longest time prevent the block from decaying will be correspondingly valuable.

A piece of wood pavement taken up in Brooklyn after it had been in use for eleven years, on a fairly heavy traffic street, showed a wear of only one-quarter of an inch; so that, assuming that the blocks could stand a wear of one inch before becoming too rough for use and that the blocks would not decay, that pavement would have a life of 44 years. It would seem to the writer that an oil of heavy gravity would preserve the blocks for a longer time than one that was lighter.

The same argument would seem to hold good as regards the amount of treatment to be used. In Europe the general practice is to use about 10 pounds of oil per cubic foot. There, however, as a rule the pavements wear out before they rot out, on account of the much heavier traffic that comes upon them. In Paris and London wood is laid on the heavy traffic streets. One reason for this is because the pavement is so nearly noiseless.

How Much Oil?

The early practice in this country was to use 20 pounds of oil per cubic foot. This practice to a number of people has seemed to be excessive, and the quantity has been reduced to 16 pounds and sometimes to 14 pounds per cubic foot. If 16 pounds is sufficient, it is a waste of money to use 20 pounds, but if 20 pounds will prolong the life of the pavement more than sufficiently to pay for the extra cost of the 4 pounds per cubic foot it should be used. It will undoubtedly take some time to demonstrate what is the proper amount under different conditions. It can be said, however, as a general principle, that the heavy traffic streets will not require as much treatment per cubic foot as the light traffic streets.

It is also argued against the larger amount of oil that the pavements are more liable to "bleed", that is to cause the treatment to exude upon the surface of the street, than if the smaller quantity is used.

Joint Filling.—There is also considerable variation in the use of joint filling, the materials being cement grout, pitch, and sand. The same arguments can be used as regards the filling as with the stone blocks generally, except that sand is not considered permissible under any conditions in stone or brick pavements. The idea is to protect, by the filler, the edges of the stone or brick from undue wear. As the edges of the wood blocks are smaller than in either stone or brick, and as the wood is tougher than the stone or brick, this joint is not so important.

The Use of Pitch

One argument against the use of pitch is that when the blocks expand the pitch is apt to be crowded out upon the surface of the street, thus adding to the nuisance of the bleeding, but, on the other hand, it is urged that when pitch is in each joint, these joints each become an expansion joint and so lessen the liability of the bulging of the pavement. Where there is a reasonable amount of traffic the writer believes that the best results will be obtained by the use of fine, dry sand.

Cushion.—Two kinds of cushion have been in use in wood pavement, one a mortar bed consisting of one part of cement to three or four parts of sand, and the other of sand. The objection to the mortar bed for wood blocks is less than for stone or brick, because the wood itself is a resilient material, so even if the bed is solid, it does not present a solid construction. The writer believes that a smoother surface can be maintained with a mortar bed than with the sand cushion. In Europe the blocks are laid directly upon the concrete foundation. This, however, necessitates the concrete having so smooth a surface that the blocks will bear evenly upon it. As gravel is used in Europe almost entirely for the concrete foundation for pavements, this result is more easily obtainable than it would be with the broken stone in this country. It would entail considerable expense to have the concrete foundation struck to the smooth surface that would be necessary if no cushion were used, and it would seem that almost the same results can be obtained by the mortar bed. Sometimes, however, in Europe a coat of bitumen is spread over the concrete before the blocks are laid. This, however, is for the purpose of keeping moisture out of the bottom of the blocks rather than to serve as a cushion for the blocks themselves, as it is not sufficiently thick to serve as a cushion.

Bituminous Pavements

While some years ago coal tar was used to quite an extent in bituminous pavements, and is now to a less degree, the principal bituminous pavements are being laid with asphalt.

Sheet Asphalt.—When sheet asphalt pavements were first constructed they were laid in two courses—a half-inch course laid first upon the base and rolled, and the wearing surface laid upon that. This was not successful, and what was known as the binder course was substituted for the cushion coat. This consisted of broken stone ranging in size from 1 inch downward, mixed with asphalt, the stone being entirely free from dust. This was used for a number of years but under heavy traffic the wearing surface was driven down into the interstices of the broken stone so that the surface became somewhat rough. To obviate that, what is known as the close binder was laid. A certain amount of dust was allowed in the stone, and, where necessary sand was mixed with it so that the interstices in the stone should be practically all filled, thus preventing any spaces being left for the wearing surface to be crowded into. This has been in use for some years and is successful for heavy traffic streets. The danger in its use is that it may become so smooth that the wearing surface will not form a close bond with it.

Asphalt pavements have been practically standardized, the most important object being the asphalt itself. In the early days it was considered that only the natural asphalts were suitable for pavements, but as the industry expanded the chemists obtained a greater knowledge of the material, so that now it is possible to write a specification for asphalt that is practically sure of obtaining good material, and most cities receive bids on definite specifications for asphalt without regard to its source.

In this connection it might be said that there is some discussion as to the advisability of removing the guarantee from asphalt pavements. When asphalt pavements were first introduced, in order to have the people know that there should be no additional expense to maintain the pavement for a certain period, the contractors guaranteed to keep the pavement in good repair for five years without any extra expense. This period of five years was arbitrary, but has generally been continued. With the knowledge of asphalt that has been obtained at the present time it does seem proper to consider the advisability of it, although the writer would not advocate the abolition of the guarantee just now.

Asphalt Block Pavement.—This pavement has practically been standardized, both in the construction of the block and in the laying. The blocks have been reduced in size materially from the early construction and improved very much in quality on account of the changes in the bitumens. The early blocks were more brittle than the ones used at present, and consequently crumbled somewhat under traffic.

The blocks are laid on a mortar bed placed upon the concrete foundation, and, as the blocks themselves are resilient, it seems proper that they should be laid on a solid base. The object of the mortar bed is of course the same as with the wood—to give the blocks a firm and even bearing.

Bitulithic Pavement.—Another form of bituminous pavement is what is known as "bitulithic" or "Warrenite", a patented pavement that has come into use during the last ten or fifteen years and has been very satisfactory. It is somewhat of the same nature as the sheet asphalt pavement, except that the aggregate consists of stones of about one inch in diameter graded down to dust in a predetermined way so that the voids shall not exceed 20 per cent. This pavement has been used much more largely than any other kind of bituminous pavement except the sheet asphalt. It has been used to a great extent for resurfacing roads that had been improved with waterbound macadam.

Maintenance and Repairs

The American people have never appreciated the importance of keeping street pavements in good repair. The same statement is true of almost all public work. They have had too much the idea that a structure once completed needs no further attention. As a matter of fact all structures need constant care and repairs. This is especially true of street pavements. In fact, no city should contemplate the building of street pavements unless they also propose to keep them in good repair. Just what it will cost to do this is uncertain. American cities, in the first place, have not kept their streets in good condition, but have spent what money they have had in making repairs. Then, too, what money has been spent has not been accounted for in a way that the cost of each street can be known. The standard of good repairs is also different in different cities, and the cost of repairing streets will vary in accordance with that standard, as the better repair a street is kept in the less it will cost. This statement assumes that all of the streets will be kept in good condition, and not a few, so that traffic will distribute itself naturally over the shortest and easiest routes, rather than those which are the best paved. It also makes a great difference if the streets of a city are paved with the proper material. It is manifest that if a heavy traffic street is paved with asphalt the repairs will be much greater than if it is paved with granite, and if a residential street is paved with granite the repairs will be practically nothing for a long time. If, for instance, half of the streets of a city that should be paved with stone are paved with asphalt, the total cost of keeping the asphalt pavements of that city in repair will be much more than if only those are paved with asphalt that should be so paved.

The question, too, of paying for pavements will have some bearing upon repairs. In most, if not all, of the New England cities, pavements, both original and repaving work, are paid for out of the general fund of the city, while in New York the original pavement, and in most Western cities all pavements, are paid for by assessment upon the property owners. As has been intimated, the proper function of a city, as regards pavements, is not to pave the streets once, but to keep them paved, and the word "maintenance", as distinguished from "repairs", means the continuity of a pavement on a street, while "repairs" means simply the work necessary to be done to keep the pavement in good condition from year to year. Maintenance is the more comprehensive word and in this particular instance the greater includes the less.

In order to maintain the streets of a city in good condition and in an economical way there should be established what is known as a street improvement fund, a fund that should be continuously carried over from year to year, so that money saved in one year would be available the next. This, it seems to the writer, is so important that every city should have the right to levy a tax of a certain amount each year for the maintenance of pavements, in the same way as many cities have the power to levy a tax for school purposes. The condition of the street is extremely important in every well regulated city, and the city officials should have funds provided in sufficient amount to keep them in good condition. It is important that the fund should be continuous from year to year in order that the streets be considered as a whole, making it possible to use the money independently, expending a large or a small sum as may be necessary on any particular street to continue the pavement. When repairs are paid for out of one fund and repaving out of another this is not always possible. While it might not be practicable to adapt this principle to the needs of cities where work is done out of separate funds, still if the principle be recognized a great deal of benefit may be derived from it even under adverse conditions.

Operating 45 Plants

The Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio, has had two prominent additions to its family of licensees, the Burton-Townsend Company, of Zanesville, O., with two plants and a present daily capacity of 160,000 pavers, and The Trimble Paving Brick Company of Dayton, O., with one plant at Trimble, O., and another at Gloucester, O. These two companies are among the largest and most prosperous in Ohio. In addition, the Deckman-Duty Brick Company of Cleveland, O., another Dunn licensee, has consolidated with the Wooster Shale Brick Company of Wooster, O., under the name of the Medal Paving Brick Company. This adds one more plant to the three which the Deckman-Duty company owned—one at Cleveland, O., one at Carrollton, O., one at Malvern, O. These accessions give the Dunn company 28 licensees, operating 45 plants.

The Thompson Starrett Co., who have the general contract for the erection of the Imperial Oil Company's new building at Church and Court Streets, have opened an office at room 614 Excelsior Life Building, Toronto.

Progress on Rogers Pass Tunnel

Speed the main factor due to the enormous expense involved and the increasing demand by the enlarged railway traffic—Methods employed—Record speed attained

By J. G. Sullivan*

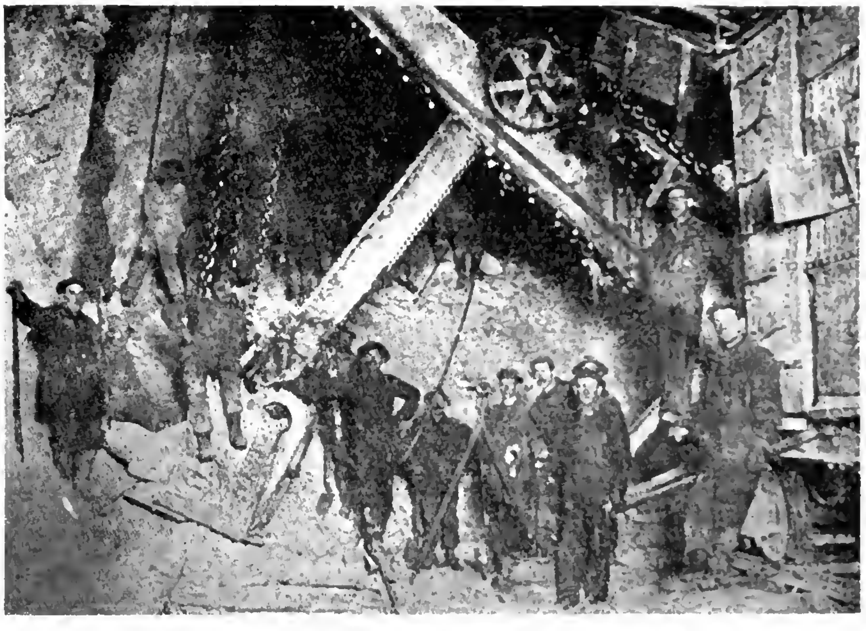
On December 20th, the east and west headings of the Rogers Pass tunnel, the new five-mile double-tracked tunnel of the Canadian Pacific Railway, were joined. The construction of this tunnel through Mount Macdonald, in the Selkirk Mountains, lowers the present high-level summit of the railway grade 552 feet, shortens the distance by 4.3 miles, eliminates some 2300 degs. or 2400 degs. of curvature, and avoids the expense and danger of maintaining and operating 4.5 miles of snow sheds.

In order that the plan adopted in the construction of this tunnel may be properly understood, it is thought advisable to go somewhat into the history of the case. During the period from 1910 to 1913 the traffic on the C. P. R. was increasing so rapidly that it was self-evident that, to be able to handle this traffic if the rate of increase continued, the road would have to be double tracked, in fact a very prominent consulting engineer who reported favorably on the recommendation of the construction of this tunnel, suggested further that it might be necessary to double track the present line over this mountain, gauntleting the heavy bridges, to handle the traffic during the time that might be required to construct this tunnel. The writer knew that tunnels in Europe had been driven at a rate two or three times as fast as any long tunnel had ever been driven on this continent, and in a superficial way had an idea of the methods employed. In a circular letter sent out to contractors dated April 8, 1913, the following statements appeared:

"The necessity for this tunnel is so great and the expenditure so large that it would be worth considerable money to this company to have the tunnel completed as soon as possible. Therefore, everything else being equal, the party who will guarantee completion in the shortest time will be the party who will receive the work. I would be glad if you would give us prices on the European method of tunnelling, which is to drive a very small heading and take out the bench, working from several headings into this small drift. Tunnels in Europe have been driven by this method at two or three times the speed that any tunnel was driven in the United States or Canada, and I would like to be able to place before the management figures for doing this work according to this method. I would be glad if you would state in your proposal the amount per day that you would be willing to have inserted in a contract to be paid as a bonus for time saved over the agreed time, the same amount to be exacted as a penalty for the time lost, being the time between the fixed day of completion and the actual date of completion. We are of the opinion that this sum should be about $750 per day."

The writer, however, was aware that at this time, the chances of American contractors tendering a reasonable figure on the European methods were very remote, in fact, after having studied some of the prices paid for labor in some of the large Swiss and Italian tunnels we were forced to the conclusion that theirs was not a practicable method for this country, where labor is so expensive. On March 15, 1913, the writer reported to the management his ideas on this subject. To quote from the report:

"Referring to the progress that we hope to make in the driving of Rogers Pass Tunnel, I advised you in my report of October 22 regarding the relative speeds of driving tunnels on the American Continent compared with those that have been driven through the Alps. I have given the matter considerable study since, and have come to the conclusion that the European method of driving a small lower heading and stoping out the remainder of the tunnel is too expensive on this side on account of the difference in the cost of labor. I have been thinking out and studying methods



Steam Shovel averages 50 ft. a day in enlarging Rogers Pass Tunnel

* Chief Engineer C. P. R., Winnipeg.—From a paper before Montreal Branch C. S. C. E.

that would tend to expedite this work. I first thought of driving a heading in the centre of the tunnel about 9 feet by 12 feet and keeping this heading close to the bench, carrying the air pipes over the muck in front of the steam shovel and into this heading. I still believe that this method in rock that will stand is better than an upper heading. Mr. A. C. Dennis, however,

Main Heading Rogers Pass Tunnel—Steam Shovel on standard gauge track at work

suggested driving a pioneer tunnel and taking out an upper heading through shafts into this tunnel, taking out the rest of the bench with steam shovels. I pointed out to him that this was impracticable for the reason that from an upper heading you cannot drill to the bottom of the tunnel, and therefore would have to clean up all the muck in the bench before you could put in a round of breast holes to break more rock. I have now made plans showing a combination of my ideas and Mr. Dennis', which, I think, is well worth studying. The plan is to drive a small working pioneer tunnel 8 feet by 8 feet underneath the main tunnel. I am sending you this for your information, and further, if this method should be adopted, that Mr. A. C. Dennis may have the proper credit for first suggesting a pioneer tunnel."

The principles that have been carried out in the construction of the tunnel are, that a pioneer tunnel is driven entirely outside the regular section of the tunnel, and a centre heading is driven in the centre of the main tunnel. The function of the pioneer tunnel is to provide a means of transporting the material from the heading to a point back of where the enlargement of the tunnel takes place, also to provide for the carrying of high pressure air pipes, water pipes, ventilating, suction pipes, etc. In other words, to provide a means so that the shooting at any point in the tunnel will not interfere with operations at other points. The idea of carrying the drills on a horizontal shaft held in place by heavy jacks was to enable these shafts and drills to be carried on narrow gauge tracks and moved backwards and forwards as required, having in mind that heavy drills, as have been used in the past, would be required. As a matter of fact, the Leyner drills used are so light that one man can handle the drill. The result has been that all drilling in the enlargement has been done from vertical shafts.

The pioneer tunnel at the east end is located 50 feet to the north of the centre line of the main tunnel, and the pioneer tunnel at the west end is 50 feet south of the centre line of the main tunnel. The mode of operation is as follows:—the drilling in the small headings is done in the usual manner, using in general Leyner drills, making an advance of 6 or 7 feet for each round of holes. The muck is shovelled by hand from steel plates into half yard cars and hauled back, either by a mule or small compressed air locomotives, the latter being used after the haul got to be a considerable distance. The muck from the headings is carried out through cross-cuts into the pioneer tunnel, where it is carried back to a cross-cut, and there carried out on a trestle over the standard gauge tracks in the main tunnel and dumped into standard gauge cars, from which point it is removed to the fills in a similar manner to the muck loaded by steam shovels in the enlargement. The muck from the heading on the west end in a similar manner goes into the pioneer tunnel at a cross-cut, crosses back to the main tunnel in a cross-cut, where it is dumped into standard gauge cars. In the enlargement of the main tunnel the drilling is done well ahead of the shooting. At first the radial holes were drilled at right angles to the axis of the tunnel. This did not give the best results, and it was changed to a drilling showing an inclination of about one in four away from the direction in which the tunnel is being driven. The muck is all loaded by steam shovels into standard gauge 12-yard capacity dump cars. The shovels have dippers of 1½ cu. yds. capacity and are worked by compressed air. The cars are hauled to the mouth of the tunnel by standard gauge compressed air locomotives and from there by standard steam locomotives.

The contract for this work was let on July 1, 1913. The limit of time for completion was three and one-half years, which would bring the time to January 1, 1917. There was an allowance in extension of time of one day for every 10 feet of soft ground that was encountered, which would require immediate timbering. There was in the neighborhood of 1,660 feet of such ground, which would extend the time limit of

Final connection of the Pioneer Tunnel—Looking west

the contract to some time in June, 1917. There was driven to December 19, 1915, 19,610 feet of pioneer tunnel; 24,612 ft. of centre heading; 1,660 ft. of earth tunnel, and 14,342 ft. of tunnel enlargement in rock. There remains to be driven: 288 ft. of centre heading; 19,398 ft. of tunnel enlargement. The best progress in driving pioneer tunnel heading was 932 ft. in one heading in the month of January, 1915, west pioneer. The best record for a week of enlargement was 267 ft. The best progress to date for a month of enlargement was 827 feet for the month of August, 1915, west end.

From April 1st, 1915, to December 19, 1915, 12,346 feet of tunnel enlargement has been made. This is about the time that the shovels were both working in rock and were working at a normal rate of speed. This same rate would require a little over seven months in which to complete the tunnel. There will, however, be some slowing up in the enlargement between certain cross-cuts which are at the end of the pioneer tunnels for the reason that at present fans are installed at the mouth of the pioneer tunnel at each end. Doors are put in the cross-cuts between the pioneer and the centre heading. All of these doors are kept closed back of the shovel, and when shooting takes place in the enlargement of the tunnel the door at the first cross-cut beyond point of shooting is opened. This creates a very strong draught back over a pile of freshly shot muck and makes conditions such that the men can return to work in ten or fifteen minutes after a shot. The shooting of the muck in the enlargement of the main tunnel is done in the following manner: one round of holes is shot at a time, the holes in the bottom of the tunnel being shot in advance of the holes on the sides or on top. In some cases the top holes are not shot until all of the bottom holes have been shot out. Usually six or seven rounds of holes are shot before the steam shovel starts cleaning up the muck, that is, a distance of 30 ft. to 35 ft. The shooting is generally continued until the tunnel becomes so full of muck that no more shooting can be done. The largest amount that was ever shot at one time was on November 20, 1915, when 84 feet was shot in eleven hours.

I may say in conclusion that all our expectations as to speed have been more than realized, and that for any rock tunnel where the rock is of sufficient hardness to stand until after the mucking has been done, that this method can be worked successfully and a speed of three miles per year can easily be made at a much less cost than tunnels driven at the same speed by the European method; and furthermore, the radial shooting has proven that a great deal less over break can be expected from this method than where holes are put in parallel with the axis of the tunnel.

This work was laid out and started under Mr. F. F. Busteed, engineer in charge of double tracking, with Mr. J. W. Shepperd as assistant engineer, and has later been carried out under the supervision of Mr. W. A. James, engineer of construction, Western lines, with Mr. H. G. Barber as assistant engineer; Mr. T. Martin as resident engineer, at the west end, and Mr. J. R. C. Macredie as resident engineer at the east end. The contractors are Messrs. Foley Bros., Welch and Stewart, construction work being supervised and managed by Mr. A. C. Dennis, superintendent for the contractors.

Canadian National Clay Products

Successful Convention of Clay Products Association at King Edward, Toronto—Good attendance and lively discussions.

The 14th annual convention of the Canadian National Clay Products Association was held at the King Edward Hotel, Toronto, on January 18, 19 and 20. Keen interest was taken in the convention as a result of the present situation in the building trades and the lack of demand for brick at the present time. About 120 delegates assembled from different parts of the Dominion. Mr. J. E. Frid, president, occupied the chair. The papers presented covered a wide range, from the various steps in the mining, storing and manufacture of clay and clay products to the best methods in selling the different products.

The Convention was opened with an address of welcome by President J. E. Frid, of the George Frid Brick Company, Limited, Hamilton, followed by an official welcome on behalf of the city of Toronto by Mayor Church. Mr. Joseph Russell, M.P.P., Toronto, replied on behalf of the delegates. Mr. D. A. Lochrie extended a welcome to the Convention on behalf of the Entertainment Committee, and Mr. Hubert Desjardins, of the Montreal Terra Cotta Company, Limited, Montreal, replied.

After the secretary-treasurer's report and the report of meetings, Hamilton was chosen as the place for the next convention. The election of officers resulted as follows: President, J. E. Frid, Hamilton; first vice-president, A. F. Greaves-Walker, superintendent Sun Brick Company, Toronto; second vice-president, Mr Thomas Kennedy, Dominion Sewer Pipe Co.; third vice-president, William Burgess, Don Valley Brick Company; secretary-treasurer, Gordon C. Keith, Toronto; councillors, C. B. Lewis, Milton; A. Graham, Toronto; W. Clark; R. N. New; H. Desjardins; A. Neall; D. A. Lochrie and J. S. McCannell.

Wednesday Session

At the morning session on Wednesday the chief items of business were the delivery of three very instructive papers and their subsequent discussion. Mr William Burgess, Superintendent of the Don Valley Brick Works, Todmorden, gave an interesting paper on "Operating Clay and Shale Pits in Canada." An instructive article on "Brick" was delivered by J. P. Hynes, of Hynes, Feldman & Watson, architects, Toronto, and Mr. Joseph Keele, of the Mines Branch, Ottawa, followed with a paper on the "Application of Salt and Quicklime in Drying Clay Products." Mr. Keele gave particular attention to the clays of the western provinces, where the difficulty of clay products cracking while drying has been very troublesome. This cracking is due to the constitution of the clays. Some clays when worked have a soapy, sticky feeling and contain large proportions of dilatinous matter and very little lime, and the surface dries so rapidly that the interior remains a soggy mass, resulting in cracks. The Mines Branch, Ottawa, have carried on extensive experiments to find some means whereby the western clays may be made into products in demand, at a reasonable cost without materially weakening or destroying any valuable properties brick should possess. Preheating might prove beneficial but its cost in Canada makes it prohibitive, when other manufacturers are selling brick at a low figure. The use of chemicals was tried. Sodium carbonate, while it aided drying, did not materially affect the stickiness. Lime also aided the drying process, but an excess of lime in the burning destroyed the red color due to the iron, giving the brick a buff color. Discussing whether washing would not remove the dilatinous material, Mr. Keele said experiments showed that washing removed 75 per cent. of the clay and left a residue which was still sticky.

Wednesday Afternoon

The afternoon session opened with an address by W. W. Pearse, city architect, Toronto. Mr. Pearse expressed his thanks to the clay workers for the hearty support given him recently in compiling data on bricks—preparatory to a revision of the building by-laws of the city of Toronto. Mr. Pearse pointed out that information or necessary data on building materials based on tests were extremely difficult to get, and in fact were practically unobtainable for Canadian materials. Such information as was procurable was based on tests made in the United States on American materials and under climatic conditions different from those in Canada. The aid of the government is needed to establish bureaus where such tests can be carried out with Canadian materials and the data compiled for the use of all municipalities requiring them. Mr. Pearse then outlined the methods used and the results obtained in the brick tests recently carried out under his supervision. Three bricks were taken, not necessarily selected, from each yard. One brick was planed to a smooth surface so that the distribution of the load would be uniform—placed on supports 7 inches apart and a crushing load applied. The modulus of rupture or fibre stress was obtained, also the bending stress and an absorption test made. It was found that neither the absorption nor the bending stress had anything to do with the crushing stress. Mr. Pearse pointed out that after careful investigation he had been able to classify the various qualities of brick manufactured in Toronto and he stated that the brick made here was as good, if not better, than that made in the States. "Bricks made in Toronto are classified into three groups," said Mr. Pearse, "A., B. and C. The first class of brick is considered the best brick, and when a certain class of building is to be erected in this city we call for this class. The second is just a little inferior and would be good for buildings which would not call for Class A. And the last, Class C., would be used only on one class of building. By this means we will know exactly what class of brick will be used in each building, and after the tests that have been made I am certain that the buildings will be better."

Mr. J. E. Frid, Hamilton, President of the Canadian National Clay Products Association, 1915 and 1916

Passed Resolution

Mr. Pearse asked for the co-operation of the clay workers to establish this bureau and would like to see tests carried on under actual conditions, such as in a wall, the effect of eccentric loading and the relative merits of lime and cement mortar in the final strength of the walls. Following the discussion the following resolution was passed:

> "Resolved, that we, the Canadian National Clay Products Association, urge that the Dominion Government, through the Commission of Conservation or other branch of the public service, extend the work they are carrying on at McGill University, Clay Testing Laboratories at Ottawa, etc., so that they can establish a central bureau and supply accurate information on Canadian building materials to all municipalities requiring same."

The need for something of this nature was shown at the inquiry into the causes of the collapse of the chimney at the new gymnasium of the University of Toronto, where no one could testify how much weight green mortar would sustain. The necessity for compiled data on Canadian fireproof material is very pressing and it is high time Canadians had their own data.

Following Mr. Pearse, Mr. A. F. Greaves-Walker, manager of the Sun Brick Company, Toronto, gave a very interesting and detailed paper on "Hollow Ware Dies, Troubles, How to Correct Them." This paper was of especial interest because it is such a vital question to many manufacturers. Dies, whether they be real new ones or have been used before, invariably need adjustment the first time they are used in a new plant. The conditions that govern the working of dies vary so extensively that a die operating very successfully in one plant may refuse to work in another doing similar work. The causes are numerous, but if properly studied can, as a rule, be easily remedied. In round uniform tile dies there is not much difficulty encountered, but with the complication of the parts, the addition of webs, etc., the difficulty of obtaining a uniform flow of clay throughout becomes manifold. Flow will take place along the line of least resistance, and if the sections are not properly balanced a fast flow will take place in the middle or the side, or in some particular web, with the result that the texture is different, and when the product dries it warps or cracks. Whenever possible, correct fast flow by reducing the area at the fast point or put a baffle of iron or wood on the back of the die. This slows up the flow but very materially increases the horsepower necessary to operate the machine. Or, increase the area of the slow flow. The dies are an important factor in the texture of the finished product. Dies are classified as follows: (1) Dry, lubricated, (oil, water and steam); (2) flat, or tapered; (3) face-plate (flat or tapered). Dry dies should be used if possible with flat dies for such wares as drain tile and a tapered or compressing die for fireproof wares.

Other features to consider in eliminating bridge cracks are, the distance of the bridge from the point of issue and the condition of the face of this bridge. Frequently small adjustment of the bridge either way or roughening or polishing the bridge face, will eliminate otherwise troublesome cracks which appear after drying. The size of the grains and the speed of the machine are other factors to consider. A small grain requires a higher speed than a larger grain. Quite often this factor cannot be remedied on account of the use of constant speed steam engines, but with the advent of variable speed electric motors, better results are being obtained. The auger also bears an important relation to the quality of the finished product. Single wing augers, while they give the fastest flow, tend to drive the clay too fast in the centre. This fault is overcome by the use of two-wing augers and still further by the three-wing, which give the most uniform flow. If, after all these factors have been considered, and the product leaves the die in apparently perfect shape, it be not properly dried, it will still develop cracks or warp. Great care should be taken in drying hollow ware products to have it heated uniformly throughout. This is best accomplished by spacing or by blowing warm air up through the wares. Never pack die products close together, and let air sweep over the top because this dries the tops first, sets up a lateral stress in the tile and produces a hair crack completely round the tile, which may not be detected. When the tile is subjected to strain, however, it often falls in two.

The annual banquet was held in the Prince George in the evening. The patriotic spirit was strongly in evidence at this banquet, practically all the speakers referring to the war crisis and Canada's participation in it.

Thursday Session

Mr. Chas. A. Miller, Inspector of Clay Products Plants under the Workmen's Compensation Act, resumed the session on Thursday morning with an address on "Safety in Clay Products Plants." Mr. Miller gave the statistics on accidents during the year 1915. These show that the railroads claim the greatest number of victims, with the iron and steel industry making almost as heavy a toll. In the clay factories of Ontario no fatal accidents occurred, and only about sixty serious cases were reported. Statistics show that the majority of accidents occur in the clay beds, rolls, gears and from cables and set screws. The discussion, which was very spirited, pertained chiefly to the Workmen's Compensation Act, and the effect on the company as well as the workmen. The question of first aid to an injured workman came in for a heavy share. Who should pay the doctor who is called in for first aid? The company are not bound to call him under the Act. All they have to do is send the man home and notify the Board and it may be some time before the Board can adjust the case and pay the victim. In the meantime he might starve. If the company calls a doctor he can come on the company for his fee. This is one item that needs attention, but it was the opinion of the Convention that the Act is a valuable asset and in time will become adjusted to the special conditions and be a very valuable factor for good.

Future of the Face Brick Industry

"The Future of the Face Brick Industry in Canada," by F. R. McCannell, managing director, Milton Pressed Brick Company, Milton, was the next paper and one that just at present is a live item among brick manufacturers. The future of face brick depends on how good a product can be manufactured at as low a cost as possible. Manufacturers should keep an accurate cost system in the plant to see that they are getting the proper amount of work in the different departments for the given expenditure, establish standard methods wherever possible and form a central bureau, employing a competent man to look after credits and collections.

The discussion hinged largely on the relative merits of rough and smooth-face brick. Rough-cut brick, which has been in popular favor for some time, composes about 75 per cent. of the United States face brick. But the death knell of rough-cut brick in the east has been sounded. The fact that it collects dirt overcomes its advantages in color range, and it is not a brick for down-town sections. The trouble in the brick business, especially in the States, is the hobby for something new, different from the last type used. The salesmen advocate a change, the owner calls for something different, and the manufacturer loses money because he cannot use standard methods and manufacture one kind straight ahead.

The paper on "The Clay Deposits of Southern Saskatchewan," was a report on the valuable clays of that district, their occurrence, uses and exploitation, by Mr. N. B. Davis, of the Mines Branch, Ottawa. With the decreasing supply of clays in Ontario and Quebec, attention naturally turns to the western provinces. Have they a supply to fall back on? It is quite evident from Mr. Davis' paper that they have. There is an abundance of refractory clays for stone wares and white wares as well as for burned clay products, in Saskatchewan.

The afternoon session on Thursday was given over principally to a discussion of the business end of clay-working plants. Professor Wiggins, Inspector of boilers, gave the delegates an instructive address on the steam end of a clay-working plant; how to overcome waste, increase the efficiency, and lower overhead charges.

Mr. Greaves-Walker read an instructive paper on "Clay Preparations for Stiff Mud Products," prepared by Prof. Roy T. Stull, ex-director of Ceramics, University of Illinois. A product is no better than the material it is manufactured from. Of course, a poor man may spoil good material, or an expert may make a fairly creditable product from a poor material. In the clay industry, following this idea, great care should be taken from the time the clay is mined till it goes into the machine, to get a uniform grade of texture. Prof. Stull advocates storage. After mining the clay it should be ground, screened and stored so that with a change in climatic conditions no change results in the clay going to the dies. If one part is drier than another, when the ware is made and set out to dry, the drier part absorbs moisture from the wetter portion and causes the ware to expand and necessarily crack or lose strength. The use of storage with an automatic feed is advocated to procure a uniform grade of texture.

Selling Brick

The secretary then read a paper from Mr. L. H. Wiers, of Thompson Brothers, Windsor, on selling brick. Mr. Weir says that to sell brick to advantage one must:

1. Run an advertising notice in the daily papers and change it often.
2. Educate the people on the merits of brick.
3. Never leave a customer dissatisfied, even after all other methods failing, you have to remove your brick for some other.
4. Quote one price to everyone and stand by it.
5. Read every trade journal on brick you can find.
6. Know your own products.
7. Always sell firsts as firsts, and seconds as seconds.
8. Don't get lazy.
9. Know all you can, tell all you can, to everyone you can, about brick.

The question whether to quote one price to every customer brought forward some healthy discussion. The consensus of opinion appeared to be that it was wisest to agree on one price but set different terms, make sure of a prospective buyer's security, tell the truth in all matters, stick to your contract, and in all cases satisfy the customer. Never sell a second for a first. Set a standard and keep to it. The trouble with the brick industry at present is that the buyer knows more about the price than the salesman. You manufacture all right but have poor salesmen. It would be wise when you go for a brick contract to take a brick with you to keep your feet warm. The convention adjourned to meet next year in Hamilton.

The Dearborn Chemical Company of Canada, Limited, presented all delegates with a faced blotter bearing their advertising. Mr. H. E. Hunt gave a six-inch ruler bearing the words "The rule is to have your brick moulds and wheelbarrows manufactured by H. E. Hunt, Toronto." The Federal Engineering Company, Limited, presented all delegates with a small leather-bound vest pocket memorandum book.

Visited Technical School

At four o'clock Tuesday afternoon, on invitation of Dr. A. C. McKay, principal of Toronto Technical School, the clay products manufacturers paid a visit to the new clay products and construction laboratories at the Technical School. Among the different machines inspected with interest were:

A No. 2 Kels machine, complete with 8 ft. x 20 in. end delivery pug mill, hand cutting table, tile, brick and hollow ware dies, supplied by H. C. Baird & Son, Parkhill. The total length of the outfit is about 16 ft., the width about 4 ft., and the height about 4½ ft. Automatic cut-off table, by B. E. Bechtel, Waterloo. Martin brick machine, by the Sun Brick Co., Toronto. Set of Moulds, by H. E. Hunt, Toronto. Firebrick for kiln—Elk Fire Brick Co., Hamilton. Face brick—Don Valley Brick Works, Toronto. Grate—Canadian Steam Boiler Equipment Co., Toronto. Kiln iron—Baines & Peckover, Toronto. A number of clay products manufacturers have supplied samples for the museum building products. In the evening the delegates were the guests of the Entertainment Committee at a theatre party at Shea's Theatre.

Paying the Quantity Surveyor

By William Groves Smith*

The greatest obstacle confronting those engaged in the introduction of the Quantity Survey Method has been the question of payment of the Quantity Surveyor's fee.

Architects appreciate the great assistance a Quantity Surveyor can give.

Contractors are well aware of the heavy expense of taking off quantities on job after job that they do not win.

Everyone in fact who is well informed feels the defects of the customary methods and knows that something ought to be done about it. But how?

Architects cannot afford to pay for a Quantity Surveyor out of their fees.

Contractors cannot agree on a method for dividing estimating cost. Several attempts at Contractors Central Estimating Bureaus have failed.

For a long time the only way seemed to be to have the building Owner pay directly for the Quantity Survey. This is perfectly logical and would be a profitable investment for him. Unfortunately, however, this method of payment demands the Architect's recommendation to the Owner and entails a lot of educational work before the average Owner can understand wherein he will profit by a Survey. Many architects shrink from this task.

We propose the following simple and fair method, as desirable and profitable to all parties.

Our Fee Payment Plan

The architect will decide how many general contractors may bid, say ten.

Divide our fee by ten.

Charge each general contractor that amount for a complete Quantity Survey of all trades.

Each general contractor can collect from his subcontractors the proper amounts for Bills of Quantities in their trades.

In this way each contractor will receive accurate itemized quantities, at a fraction of the expense to which he would be put to take off quantities himself.

Advantages

It leaves control of the whole matter in the hands of the architect.

It saves estimating expense to the contractors.

It assures close, intelligent bids to the Owner's advantage.

Details

The architect has only to instruct his contractors that he will use guaranteed uniform quantities as a basis for bids.

The architect can collect our fee or can instruct the contractors to get the Bills from us at a price agreed upon with the architect.

No change in the usual form of contract is necessary.

We will give an acceptable surety bond guaranteeing the quantities to the successful contractor or to the building owner.

This plan does not alter our policy of giving all the service demanded by the Architect and Owner in the nature of estimates and quantities from the sketch plan period to the completion of the building.

Amount of the Fee

Our fee varies from ¼ per cent. to 1½ per cent., according to the size and character of the job.

* In the Engineering Contractor

Motor-Driven Street Flusher

The increased area of paved city streets and the more general recognition of the necessity of the thorough cleansing of pavements has naturally stimulated the design of street cleaning equipment while the substitution of the gasoline motor for the horse to furnish motive power has made possible the building of machines of this kind of greater capacity and efficiency than was possible under former conditions.

One of the street cleaning machines which have been put on the market recently is the motor-driven street flusher shown in the accompanying illustration.

Briefly described, the flusher consists of a 6-ton motor truck chassis, equipped with a 6-cylinder Continental motor. Mounted on the chassis is a 1,500-gal. water tank and the distributing mechanism which includes an additional gasoline motor and a centrifugal pump for discharging the water under pressure. The pump motor is a 4-cylinder, 20-HP. Continental motor and is located at the rear of the tank. The 2½ in. centrifugal pump is capable of delivering 250 gals. of water per minute at a pressure of 70 lbs. per sq. in. There are four discharge nozzles, one on each side about half way between the front and rear wheels, and one at each side at the front of the machine. The nozzles can be operated singly or in any desired combination, and are so arranged that by driving down the center of the street the entire width of the pavement can be flushed at one operation.

Sprinkling nozzles which are interchangeable with the forward flushing nozzles are also provided, so that the machine can be used for both power flushing and sprinkling and gravity sprinkling.

The pump motor, as well as the motor for driving the truck, is controlled from the operator's seat, the two motors being entirely separate. Any desired water pressure may be maintained reardless of the speed of the vehicle and is one of the chief advantages claimed for the machine.

Another is that the two motor arrangement is more economical as the extra horse power required for operating the pump need not be provided for in the vehicle motor and the flusher motor is in operation only when flushing is being done.

The entire separation of the propelling and water pressure systems also makes it possible to remove the tank and use the chassis for other purposes during that season of the year when street flushing is impractical. Where hydrants are not available for filling the tank, a special attachment can be provided for drawing the water supply from rivers, creeks or other sources.

New Method for Producing Pure Iron

It has been recently announced by the University of Illinois that a new method of producing pure iron, whereby a great saving can be effected in the electrical industries of the country, has been discovered by Trygve Yensen of the experimental bureau of the university. The new method consists in melting electrolytically-refined iron in a vacuum, and this reduces the impurities to a point far below that which has been reached by previous investigators. The magnetic properties of this vacuum-fused iron have proved to be as remarkable as its purity, its maximum permeability being reported to be about 20,000, or about seven times that of the sheet metal commonly used for transformer cores. The practical result of this investigation is obviously that the amount of iron required for the magnetic path in electrical machinery of all kinds can be reduced very materially and the magnetic losses may be largely decreased. It is said that the University of Illinois has declined to permit a patent to be taken out on the process, as it is believed that the benefits from it should accrue to industry as a whole.—Elec. Ry. Journal.

Motor-driven power flusher Flushes entire width of street.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

John Thompson, son of the late Sir John Thompson, is receiving a lot of credit from the Tory press because he not only gave his services gratis as prosecuting attorney with the Davidson Commission but afterwards volunteered for active service at the front. But in this cold world a man is judged not by what he volunteers to do but by what he actually accomplishes. Mr. Thompson conducted the affairs of the commission so well that while one or two minor offenders were mentioned in despatches none of them could in any way be connected with any part of any political machine. He has closed the investigation without discovering anything. It can be truly said that he has conducted one of the most successful investigations in the political history of Canada. But why should he be asked to do all this good work gratis? Is the government of Canada so poor that it must accept volunteer counsel for one of its specially appointed courts? What one gets for nothing is generally worth just what it costs. Anyway who ever heard of a lawyer giving anything, even advice, for nothing? And when Mr. Thompson goes to the front will he go as a private? Or will he carry one of those nicely engraved commissions that so many of our patriotic fellow-countrymen are pulling for?

* * *

The Minister of Militia has asked that "men of standing in business, professional or mechanical life, will send their names to him." He conveys the idea he wants them as officers for he is further quoted as saying "We want to know who is who before we make appointments or permit the raising of any new regiments under new auspices." But naturally the question arises as to whether the Minister means what he says or is simply making a bluff to cover some of the practices that have hitherto governed the appointment of officers. Let me cite an example. A well-to-do financial man of Toronto was anxious to do his bit. His years and experience did not exactly fit him for too heavy work, but in this hour when every man is needed, he thought he might act as paymaster, thus relieving some husky young officer for more active work. He wrote to Ottawa for an appointment and was referred to the officer commanding No. 2 Division. The latter told him his application would receive consideration. Some days later a friend called him aside and told him he would get the appointment but he had first to secure the influence of two Toronto men, local members of the Provincial Parliament. He told the whole bunch to go to Hades—wherever that is.

* * *

Now if Sir Sam was as frank as he is loquacious would he not have wound up his statement with "only those having political influence need apply." For the past has shown that numbers of officers have been chosen not because of their fitness or capacity but for the amount of political pull they can develop. There are hundreds of incapable Canadian officers now stalled in England, so I am told. They may easily be found around the Savoy Hotel in London, having a good time at the expense of the Canadian taxpayer. With rare exceptions the efficient have reached the front. They have helped cover Canada's name with glory. But thank heaven that every officer whose pull and influence secured him an appointment has not been allowed to reach France.

* * *

But why should this sort of thing be permitted in a country that is partially intelligent, more or less free and inclined to be democratic? Why should we be the victims of a party system that is all the more contemptible because it is half hidden under a cloak of hypocrisy? If "to the victor belongs the spoils" is to be the party system of this young country let us be open and above-board about it. Let us not fool ourselves with the idea that government is being carried on by the people for the people but announce to the world that our governing is by the party for the party. In short, if we are to have a patronage system, give us one of the good old Yankee variety, where every office holder pay tithes to the party and knows the costs of a job beforehand. They make no bones about it. This sneaking method of pretending virtue while practising deceit fills us with disgust.

* * *

Canada has now more than a hundred knights—more than could find place at King Arthur's famous round table. She also has a minor aristocracy made up of honorary colonels, etc. And while the wearers are doubtless proud of their titles it is doubtful if even those who have honestly earned them are more respected because of them. There are others of course who hang to a rather precarious fame by the handle their title affords. But great Canadians do not require a title to keep their memory green in the minds of their country; others who have been "honored" by their country or rather by their party, do not receive more respect because they have been hung on a hook a trifle above the democracy that is the backbone of every new country. Sir John A. Macdonald is still "John A." to the men who loved and followed him; Alexander MacKenzie still holds a place in Liberal hearts that will never be attained by many a man who has been "decorated by his King." If titles have any value at all in Canada it is because they foster democracy. The man who refuses a title is a patriot; the man who accepts one is often more or less of a joke.

* * *

The following from the Ottawa Evening Journal of the 10th inst. speaks for itself:

"In talking over the matter, Sir Sam Hughes mentioned that his chief intelligence officer was a Canadian of German birth, whose father was now an officer in the German army, whose mother was the daughter of an Austrian general, and whose brothers were officers in the German army. This officer is described by General Hughes as one of the very best in the Canadian army."

* * *

The suit entered against the heads of the Canadian Northern Railway for the return of money paid for land in Port Mann brings fresh evidence that there are other ways of exploiting the public besides floating loans at Ottawa. When the Grand Trunk Pacific was building, thousands of townsites sprung up ahead of the construction work. There was always the one who knew where the townsite was to be plotted. He informed his friends. They got in early and waited for the rush. Many a man cleaned up a tidy nest egg in this simple way. But according to the allegations against the C. N. R. all rights were reserved so far as Port Mann was concerned. It, a secluded spot on the banks of the Fraser, was to be the Pacific terminus of the greatest transcontinental railway ever built by Canadians with the money of other Canadians. It was surveyed and slashed. One or two streets were even relieved of their stumps. Then lots were sold both wholesale and retail. Lots three-quarters of a mile from the modest wharf brought from $2,000 to $3,000. Everybody in B. C. and a lot of folks besides bought these lots as if they were solid gold. But alas they were only gold bricks. The C. N. R. moved its terminus on to Vancouver, the wind oozed out of the Port Mann boom and that secluded spot on the Fraser resumed its ancient and honorable place as part of British Columbia's matchless scenery. And now some folks are so inconsiderate as to want their money back. So unreasonable of them too.

* * *

The dignified and talented president of the Bank of Commerce has paused for a moment to hand us a little more advice. He tells us we should economize. He doesn't go a step further and tell us to put the money we save by our economy in the bank. Why should he? Any fool knows that the only way to start saving is to open a savings account. And when the bank gets it of course it will help to carry on the war to a successful issue or help to move the crop. Of course it will—or at least that part of it that isn't sent on to New York to be put out on call loans to Yankee stock speculators and stock brokers. Or maybe it is needed to be loaned to Canadian promoters for investment in Brazil and Mexico. When hard times strike this country our banks immediately proceed to economize by refusing business men the necessary funds to carry on legitimate trade. Does the money they refuse lie idle for that reason? Well, not according to the annual bank reports.

* * *

The same government which pays 5½ per cent. interest on war bonds keeps the rate of interest on post office savings at 3 per cent. Does said government wish to convey the impression that its bonds are twice as great a risk as money in the post office, or is it merely trying to create a market by offering bonds at bargain prices? Surely the government wants the people to save. Why not pay them a more attractive rate of interest till they have saved enough to invest in bonds? Why not encourage thrift among our people?

* * *

Will the Minister of Militia deny that he is directly or indirectly financially interested in the Ross Rifle Company?

* * *

The Shell Committee, its alleged crimes and self-asserted virtues, has been brought before Parliament by Dr. Pugsley, a Liberal statesman who has probably been taught that he who is without sin should throw the first stone. It is to be regretted that what should be only a business proposition is thus being made more and more of a political question. It is unfortunate that Sir Robert Borden failed to listen to the voice of the more independent of the Conservative press and order a full and free investigation into the workings of that committee. If there was nothing to hide he had nothing to lose. If there was something to hide a full investigation ordered by himself would free him from all blame and responsibility. Dr. Pugsley has made so many charges, though insignificant in comparison to the real facts, that an investigation should follow and if any or all of the charges are sustained the Government must share responsibility with the Shell Committee and the profiteers. I have felt from the first that such an investigation was necessary for the protection of the manufacturing interests of Canada and with me those interests come before the political welfare of Sir Robert Borden, whom in many ways I admire.

* * *

In a recent issue, concerning shell committee charges, the Montreal Star, (Con.) says:

"In any case, the Government cannot permit these shocking and humilitating charges to remain uninvestigated."

* * *

That the indiscriminate handling of support for soldiers' families is working out badly in both directions is shown in numerous instances. A private in a certain platoon in the — battalion boasts that he is at present drawing $160 per month whereas he never before drew more than $50 per month. He is an employe of the T. Eaton Company, which generously allows him full pay and he gets in on all the funds. On the other hand an acting-sergeant informs me that although he has been at the Exhibition camp for nearly a month his dependents have not received a cent from any source and that even part of his pay has been held back for fear he'll elope with his uniform. Some kinds of patriotism are too profusely fertilized and some are simply starved. But then no British people ever did develop a government that was big enough to handle a war.

* * *

To all appearances the British people have awakened and decided to "get on" with the work. The British papers are warning, mildly as yet, the world not to tread on the lion's tail. The London Standard puts it:

"Germany is now clothed in a white sheet. She and America are joining hands in the noble task of bullying the nation that has respected every law of humanity and has persistently interpreted the law of nations to her own disadvantage.

"Poor England. No moral crime can be laid at our doors, but we are interfering with the war profits of American manufacturers, so we must raise our blockade and thus prolong the war, and this is asked for in the name of humanity.

"There is one comfort for us miserable sinners: President Wilson and Count von Bernstorff will knock at our door in vain."

* * *

The attitude of our Australian cousins towards the munition-making business is in humiliating contrast to the conditions under which this work has been carried on in Canada. Over in Australia, Government and private factories scorn to accept exorbitant "blood" profits at the expense of the lives of their sons and brothers at the front. As an example we may quote the West Australia War Commissions Company, Limited, organized when the war broke out under state supervision by leading public and business men of the state. The whole capital was furnished by public supscription on the understanding that there should be no dividends and that the price of the manufactured articles should be as nearly as could be fixed the actual cost of those articles. It was further stipulated that any profits remaining after the repayment of the paid-up capital after the war should be devoted to patriotic or charitable purposes incidental to the war. The same spirit evidently animates private companies, who have undertaken contracts from the Government at certain named prices on the understanding that if these are greater than the actual cost of production of the article the balance shall be refunded.

In comparison with this truly patriotic attitude Canada merely offers examples of the operations of our late shell committee such as the original letting of contracts at $6.70 per unit which have later been reduced to $1.85; the boasts of our financial magnates of huge war profits; and the scandals attaching to other purchases.

If these men, our leaders, represent Canadian culture, is not the world saying that it at least compares "favorably" with the German type?

* * *

After a long silence the peeved voice of the Opposition Leader is again heard in the land He should be ashamed to criticize the Government, even if they deserve it He has waved the British flag, he has told us what a great Britisher he is, but has failed to live up to it. What is he doing to induce his countrymen to play their part in the cause of freedom? If his is a "soul so dead" that he cannot speak in favor of the British Empire, can he not at least keep those of his own kidney, like Bourassa and Lavergne and Croquette quiet?

* * *

When are we going to get some information concerning the Ross Rifle? Rumors suggest that after the disastrous fight at Langemarck the British Government made a report to Ottawa concerning the rifle. If so, why is this report not made public?

SEARCHLIGHT.

Personal

Mr. A. McKenzie Brydon announces that he has withdrawn from the firm of Lindsay, Brydon & Greig, and has for present address 204 Glencairn Avenue, Toronto.

Mr. H. F. Secord, architect, Toronto, has moved his office from 17 Queen Street East to 2 College Street and is now associated with Messrs. Geo. N. Molesworth and Gordon M. West, who are on active service. Captain Molesworth is with the 124th and Lieut. West with the 81st battalion.

Mr. E. Laurie, of the E. Laurie Company, Montreal, agents of the DeLaval Steam Turbine Company, is now in England, having joined the Aviation Corps there. Mr. Laurie received a portion of his training in aviation in Canada. The agency of the DeLaval Company will be continued as before by the E. Laurie Company in Montreal.

Mr. L. Keroack has become associated with Mr. J. O. Marchand under the firm name of Marchand and Keroack, architects, 164 St. James Street, Montreal. Mr. Marchand is the surviving member of the old firm of Marchand and Haskill; the latter died about two years ago, and since then the business has been carried on by Mr. Marchand. Mr. Keroack is one of the younger members of the Province of Quebec Association of Architects.

Obituary

Mr. G. D. Walters, chief agricultural engineer for the irrigation branch of the Department of the Interior, Calgary, is dead.

Mr. James Carr, a well-known resident of Woodstock, Ont., died recently, after a few days' illness, at the age of 78. He was president of the Good Roads Association, and an expert in that branch. He was also agent for the immigration department of the local government. He was born in Woodstock, and spent nearly all his life in that town.

Mr. Alexander Ramsay, president of the A. Ramsay & Son Company, paint and varnish makers, died suddenly on January 14 at his residence, Argyle Avenue, Westmount, aged 76. Mr. Ramsay was a native of Glasgow, but was educated in Montreal, and in 1867 acquired the paint and varnish business established by his father. Under his direction the trade increased very largely.

Charles Conrad Schneider, an eminent bridge engineer, and a past president of the American Society of Civil Engineers, died at his home in Philadelphia on January 8. He was 72 years old, and during his professional career had been the recipient of many high honors. He was appointed a member of the Quebec Bridge Commission, which investigated the failure of the old Quebec Bridge in 1907, and of the later commission appointed in 1911 by the Canadian Government to supervise the construction of the new bridge. He was awarded the Rowland prize and the Norman medals by the American Society of Civil Engineers for excellent papers on his design of the Niagara cantilever bridge (1886), on structural design of buildings (1905), and on movable bridges (1908). Mr. Schneider was born in Saxony, Germany, in 1843, and graduated as a mechanical engineer from the Royal School of Technology at Chemnitz in 1864, coming to America in 1867. He designed several long span bridges, among them the Fraser River cantilever bridge for the Canadian Pacific Railway in 1882 and the Niagara cantilever bridge in 1883. He designed, with Mr. F. B. Kunz, the Reversible Falls steel arch bridge at St. John, N.B., and was consulting engineer until its completion in 1915. He was the author of General Specifications for Railroad Bridges (1886), for Highway Bridges (1901), and for Structural Steel Work in Buildings (1905).

The death is announced of Mr. Alexander Graham, superintendent of construction in the chief engineer's branch of the Department of Public Works, Ottawa. At the time of his death he was engaged on Government work at Sturgeon Falls, Ont. The late Mr. Graham was born at Bell's Corners fifty-one years ago, but had resided in Ottawa for the greater part of his life. Previous to his connection with the Government work, he was interested for many years in the manufacture of brick and cement blocks.

Mainly Constructional

East and West—From Coast to Coast

The Premier Granite & Sand Company, Montreal, have registered.

The Western Ontario Clay Workers Association will meet in convention at London, Ont., February 22 and 23.

Mr. D. A. F. Graham, of the engineering staff of the C. N. P. R., has been made resident engineer of the company for the city of Vancouver.

A conference on Road Construction for County Road Superintendents and Engineers will be held at the Parliament Buildings, Toronto, February 8-11, 1916.

For the year 1915 the total value of building permits at St. John, N. B., was $346,275. In 1914 the figures were $515,300.

The Constructors' Association of Quebec held their annual assembly in their rooms at 23 St. John Street, Quebec, on January 17. A large number of members were present.

The Board of Control of the city of Toronto have recommended the acceptance of the offer of Mr. C. S. Townsend for a concrete bridge at Mount Pleasant Road for the sum of $45,000.

At the annual meeting of the Manitoba Architects' Association held in Winnipeg on the 17th inst., Col. J. B. Mitchell was elected president; L. H. Jordan, vice-president, and R. G. Hanford re-elected secretary-treasurer.

Nobert-Dugre-Arsenault, Limitee, is the name of a firm incorporated recently to carry on the business of general contractors and builders and civil engineers at Three Rivers, Que. The capital stock of the company is ten thousand dollars.

The Automatic Sprinkler Company of America, Limited, has been incorporated to carry on business in Montreal, with a capital stock of $10,000. The incorporators include T.

Chase Casgrain, E. M. McDougall, and P. F. Casgrain, all of Montreal.

It is stated that Mr. Charles D. Campbell, city engineer of Galt, Ont., has resigned his position in order to give the Council a free hand in connection with the appointment of an engineer under the new by-law reorganizing the Works Department of the city.

Messrs. A. Lindstrom and Nelson, who for several years have been foremen with the Scott & Hudson Building Company, have formed a partnership under the firm name of Lindstrom & Nelson, and will embark in the building and contracting business at Kenora, Ont.

There is a report that the Ross Rifle Company, now employing over 1,500 men and paying two million dollars in salary annually, may leave Quebec and establish in Lindsay, Ont., if their application for an extension of ten years to their exemption from taxes is not granted.

Building statistics for the year 1915 for St. Boniface, Man., are as follows: January, $13,500; February, $70,000; March, $12,135; April, $19,800; May, $14,425; June, $18,550; July, $138,600; August, $1,400; September, $1,650; October, $400; November, $700; December, $2,600; total, $296,760. The total for 1914 was $803,442.

The fair wage officer of the Montreal Council has asked the co-operation of the Builders' Exchange and the Trades & Labor Council in drawing up a fair wage schedule to be inserted in all civic contracts for the present year. In 1915 the schedule was first drawn up and the comments of the Builders' Exchange then requested.

Builders Sales, Limited, is the name of a firm incorporated with a capital stock of $100,000 and head office at Ottawa. The company will manufacture and deal in iron, steel, metals, rails, machinery and tools, etc. The incorporators are F. W. White, E. P. Nunn, F. D. Hogg, A. T. Lewis, and H. E. Newland, all of Ottawa.

Judgment has been rendered in the Supreme Court by Mr. Justice Maclennan awarding the Nova Scotia Construction Company the sum of $175,332 for work done under various contracts in connection with the power company's hydraulic development at St. Timothy. It is stated by the power company's attorneys that an appeal against this judgment will be entered.

Statistics compiled by Mr. Geo. A. McNamee, Secretary-Treasurer of the Third Annual Canadian and International Good Roads Congress, to be held at Sohmer Park, Montreal, March 6th to 10th inclusive, show that at least $15,000,000 will be under appropriation this year for the construction or improvement of roads throughout Canada. Of this sum, $5,000,000 is mentioned as the share of the province of Quebec.

In recognition of his services to the Exchange and of his action in answering the call to the colors by enlisting with the 111th South Waterloo Battalion, the members of the Builders' Exchange of Galt, Preston and Hespeler, at a recent meeting honored Mr. Nelson West, who resigned his position as secretary. Mr. West was presented with a small purse, and in accepting the gift expressed his thanks. Mr. Frank McAuslan was appointed to the vacancy caused by Mr. West's resignation.

That the Hudson Bay Railway will be completed and in operation in time to carry out next season's crop seems to be the opinion of the engineers in charge of the work of construction, according to a report from The Pas. The cantilever bridge over the Nelson River at Manitou Rapids, is partly finished, and it is said the work will be completed by next May. The steel is expected to be at Kettle Rapids by the first of August, where another cantilever bridge has to be built, but as the work will be done in summer-time three months will be sufficient for the construction. If this programme is followed out the road should be ready for operation by next Christmas at the latest.

The Provincial Government of Alberta contemplate the construction of a railway from Athabaska to Fort Vermilion, a distance of three hundred miles, at a cost of from eight to ten million dollars. The project includes the development of coal mines, a fleet of steamers for Peace and McKenzie Rivers, working up mining by-products, etc. The Hon. A. G. MacKay, M.L.A., of Edmonton, is said to be interested in the scheme. The loan will be met by New York bankers, and as no opposition is anticipated it is stated that work will be started with the opening of spring.

Mr. W. B. Timms of Ottawa, a mining engineer specially commissioned by the Federal Government at the request of the Imperial Government to inquire into and investigate molybdenite deposits in British Columbia, is in Vancouver. Mr. Timms, who is a graduate of Queen's University and of the Kingston School of Mines, states that molybdenite is known to exist in British Columbia in paying quantities in only one, or possibly two, places. Ferro-molybdenum is a product now very much in demand by the British Government and the Governments of all the other belligerents for the manufacture of big gun linings.

A dispute between John Quinlan and Company, Montreal, contractors, who are building the civic library, and stonecutters who are working on the job has been the subject of a report by Mr. Laurendeau, city attorney. The contention of John Quinlan and Company was that marble cutters working on machines were not entitled to as much as workmen who worked by hand, furnishing their own tools. The scale asked was 45 cents an hour, and the company paid 45 cents to hand workers and 40 cents to those working on machines for a 10½-hour day. The company considered that the latter class were overpaid as compared with other workmen. The city attorney expressed the opinion that when contractors do not pay according to the scale of fair wages inserted in all civic contracts the difference can be paid by the city to the workmen out of the deposit which contractors make with the city as a guarantee of good faith when tendering for the contract.

The annual business meeting of the Ontario Motor League was held in the King Edward Hotel, Toronto, on the 18th inst. Mr. W. A. McLean, Chief Highway Engineer for Ontario, spoke of the plans for connecting up districts at present isolated because of bad roads. The retiring president of the League, Mr. W. W. Digby, pointed out that the membership had grown from 4,600 to 5,041 in the last year. Resolutions were passed favoring complete reciprocity in regard to the interchanging of license privileges between Ontario and the United States. It was also strongly recommended that legislation should be passed making the carrying of lights on all vehicles compulsory. The Hon. Finlay Macdiarmid, Minister of Public Works for Ontario, explained the working of the new highways act, and the Hon. Francis M. Hugo, Secretary of State for New York, spoke briefly of the great benefit of good roads to the country in general. Mr. L. B. Howland, of Toronto, was elected president for 1916.

Prof. Adam Shortt, civil service commissioner, addressed the Ottawa branch of the Canadian Society of Civil Engineers at a luncheon held in the Russell Hotel on the 13th inst. Taking for his subject "War and the Engineer," Prof. Shortt dealt with the necessity of technical training among the nations of the future as shown by conditions arising in the present war. The soldier was becoming more and more a minor factor in warfare, the speaker said, for the application of technical principles had made a great change in conditions. The army with the largest number of skilled men, engineers and inventors, would win the wars of the future. The present struggle, said Prof. Shortt, had demonstrated that it was a war between engineers and engineering products on both sides, and the futility of attempting to overrun nations by mere strength of numbers had been demonstrated. The manner in which engineering had affected all walks of life, including farming, was briefly touched upon by Prof. Shortt, who said that no institution had become so highly specialized as western farming.

Mr. Frank D. Lyman has purchased the stock, assets, and goodwill of the railway and supply department of John Millen & Son, Limited, Montreal, and is now carrying on business at 323 St. James Street, Montreal, with a branch at 90 Adelaide Street West, Toronto. Stocks are carried at both the Montreal and Toronto warehouses. As soon as a Dominion charter has been granted to a new company now formed the business will be conducted under the name of Lyman & Lyman, Limited. Mr. Lyman has been manager of the department now acquired by him since it was started some nine years ago by John Millen & Son, Limited. The new firm holds a large number of import English, French, and United States agencies including The National Tube Company, Pittsburg, Pa., Shelby Seamless Steel Tubes; Ellwood Ivins Tube Works, Philadelphia, Pa., Steel, Aluminium and Brass Tubes; The Electric Service Supplies Company, Philadelphia, Pa., Electric Railway Supplies and Equipment; Link-Belt Company, Philadelphia, Pa., Silent Chain Drives; Societe Le Carbone, Paris, France, Carbon Brushes; The Chisholm & Moore Manufacturing Company, Cleveland, Ohio, Chain Hoists and Trolleys; Crouse-Hinds Company, Syracuse, N. Y., and Toronto, Ont., Electric Headlights; Graphite Lubricating Company, Bound Brook, N. J., Trolley Bushings and Graphite Bronze Bearings.

The total value of the field crops of the Dominion last year is estimated at the huge figure of $800,000,000. New high records are established, both as to quantity, quality and market value. The earlier estimates as to the grain yields of the Prairie Provinces have had to be revised upward. Canada's total wheat yield is now estimated at 376,303,600 bushels, by the latest official Government report, or 215,023,600 bushels more than the previous year.

Turbine Equipment Co.

The Turbine Equipment Co., Limited, Toronto, who handle the De Laval equipment in Canada, have recently secured the following contracts: Riordon Pulp & Paper Co. Ltd.—1-75 h.p. motor driven De Laval two-stage centrifugal pump; Dominion Coal Co. Sydney, N.S.—2-75 h.p. direct current motor driven De Laval two-stage centrifugal pumps; Brockville Water & Light Commission, for the new filtration plant—1-4,000,000 gallon De Laval steam turbine connected to a De Laval centrifugal pump through the medium of double helical reduction gears—1-3 500,000 gallon De motor driven pump—1-2,000,000 gallon De Laval motor-driven pump—1-C. H. Wheeler jet condenser, pipe, valves, etc.

Canadian Clay-working Machinery

Prominent brickmakers in attendance at the Canadian National Clay Products Association held in Toronto last week are behind a scheme for the formation of a company to manufacture clay-working machinery in Canada. At present ninety per cent. of the clay-working machinery used in Canada is manufactured in the United States. A duty of 40 per cent. makes this machinery very expensive. It is estimated that this scheme of manufacture, if carried out, will be a financial boon to the brick industry. Repairs could be promptly secured, and at a very reduced cost. The brickmakers are very enthusiastic over the scheme, and developments may be expected at any time.

Road Builders' Association

Satisfactory progress is reported on the plans of the Thirteenth Annual Convention of the American Road Builders' Association and the Seventh National Exhibition of machinery and materials which will be held at Mechanical Hall, Pittsburgh, February 28 to March 3. The programme will include the discussion of such topics as "Railway Tracks on Paved Streets," "Adaptability of Paving Materials," Bituminous Surfaces for State Highways," "Concrete Roads," "Recent Tendencies in Stone Block Pavements, Especially With Respect to Size of Blocks," "Foundations," "Control of Openings in Pavements," "Roads at Low Cost for Moderate Traffic," "Effects of Motor Trucks," "Contractors' Suggestions to Engineers," and "Brick Streets and Roads."

The Engineer and Architecture

Mr. G. R. G. Conway, M.Can.Soc.C.E., consulting engineer, Toronto, and late chief engineer of the British Columbia Electric Railway Company of Vancouver, delivered an address before the Ottawa branch of the Canadian Society of Civil Engineers on Friday evening January 21. Mr. Conway's subject was "The Engineer and Standards of Beauty," in which he urged a freer co-operation between engineers and architects in the design of engineering structures, particularly in great public works such as bridges, railway terminals, dams, aqueducts, power houses, highways, etc. The paper was fully illustrated with lantern slides giving examples of engineering structures where this co-operation had been attempted, and, in some cases, successfully carried out.

Toronto-Hamilton Highway

In crediting the equipment used on the work of construction of the Toronto-Hamilton Highway, described in our issue of January 5, we failed to note that one of the cranes used by the Comission and shown in one of the illustrations was manufactured by the Browning Company of Cleveland, Ohio.

Fine Booklet on Moncton, N. B.

The city of Moncton, N. B., have just issued a very handsome booklet describing the industrial advantages of that city. The Contract Record acknowledges with thanks a copy from Messrs. James Reid & Son, contractors, who are responsible for a large number of the fine buildings shown in this booklet.

The preliminary programme of the Twelfth Annual Convention of the American Concrete Institute has been distributed. The convention will be held February 14 to 17 at the Auditorium Building, Chicago. With the convention will be associated an exhibit known as the Cement Show.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Barrie, Ont.
The by-law previously reported as carried is for the purpose of paying for work already completed on Bradford St.

Hamilton, Ont.
The City Council are considering the construction of a sewer on Mountwood Avenue and alterations to some of those in the west end south of Aberdeen Avenue. Engineer, A. F. Macallum.

The Works Committee have recommended the construction of a drainage system on Aberdeen Avenue at an estimated cost of $7,200. Clerk, S. H. Kent.

London, Ont.
The City Council intend to start work by day labor in the spring on extensions to the waterworks system. General Manager of the Utilities Commission, E. V. Buchanan.

Niagara Falls, Ont.
The Board of Works are considering the construction of a quantity of 6-inch watermain.

Ottawa, Ont.
Preliminary grading is being done by day labor preparatory to the construction of the Rideau River Driveway. Plans for the pavement not yet prepared.

Toronto, Ont.
The Board of Control will receive tenders until February 1st for the construction of sewers on Cawthia, Connolly and Gilmour Streets and St. Clair Avenue Square. Plans and specifications at Room 6, City Hall.

CONTRACTS AWARDED

Ottawa, Ont.
The City Council have awarded the contract for supply of a quantity of 60-inch circular sewer blocks to the National Fireproof Supply Company, 78 Crescent Street, Montreal.

Railroads, and Bridges Wharves

Alberta Province
Negotiations are now progressing with reference to the construction of a railroad between Athabaska and Fort Vermillion at an approximate cost of $10,000,000. The project includes the development of mines and a fleet of steamers for the Peace and McKenzie Rivers. Hon. A. B. MacKay, M.P.P., 10619 99th Avenue, Edmonton, is interested in the scheme.

Brokenhead, Man.
The Municipality are considering the construction of a bridge over the Brokenhead River and repairs to several others. Clerk, W. J. Hoban, Beausejour.

Cameron, Man.
Tenders on the construction of a wooden bridge over the Souris River will be received until February 3rd by the Municipal Secretary, T. B. Woodhull, Hartney.

Lachute, Que.
Tenders on the construction of a bridge will be received until noon, February 3rd, by J. A. Rice, Town Clerk. Steel construction, cement abutments. Plans and specifications with the Clerk.

Toronto, Ont.
The estimates prepared by Parks Commissioner C. E. Chambers include a cement bridge over the lagoon at the Island.

CONTRACTS AWARDED

Toronto, Ont.
The Board of Control have let the contract for the construction of the Mount Pleasant Road bridge to C. J. Townsend, 79 Spadina Avenue, at $45,000, subject to the approval of Council. Concrete construction.

Public Buildings, Churches and Schools

Ameliasburg Township, Ont.
The erection of schools is being considered by the Trustees of School Sections Nos. 12 and 13. Secretaries, R. H. Fox, Ameliasburg, and Arklen Blakely, Consecon.

Athol Township, Ont.
The Trustees of School Section No. 1 are considering the erection of a school. Secretary, M. Parks, Woodrows, Ont.

Barber Township, Ont.
The erection of a school in School Section No. 1 is contemplated. Secretary to the Trustees, J. W. Thompson, Leeville, Ont.

Berthier, Que.
The Parish School Board are considering the erection of a school at an approximate cost of $1,000. Secretary, J. A. A. Lavallee, Berthier.

Casgrain Township, Ont.
The Trustees of School Section No. 1 contemplate the building of a school. Secretary, J. O'Donnell, Hearst.

Catherine Township, Ont.
The erection of a school is contemplated by the Trustees of School Section No. 1. Secretary, W. G. Laycock, Krugersdorf.

Charlottetown, P.E.I.
Tenders will be called shortly for seating required by the First Methodist Church. Approximate cost, $5,000. Secretary, E. H. Beer, 131 Richmond Street.

Currie Township, Ont.
It is proposed to build a school in School Section No. 2. Secretary to the Trustees, G. Sexsmith, Matheson.

Darling Township, Ont.
It is proposed to build a school in School Section No. 1. Secretary, James Burns, Marble Bluff P. O., Ont.

Dundas, Ont.
Oborn & Ellis, Architects, have prepared three different designs for a high School, estimated to cost between $4,500 and $8,000. The sites will be inspected by the Board of Education and a recommendation made.

Eastview, Ont.
The erection of a four-roomed addition to the school is being considered by the Public School Board. Secretary J. W. Rostetter, Cummings Bridge P. O.

Finch Township, Ont.
The erection of a school is contemplated by the Trustees of Union Section No. 3, Finch. Estimated cost, $12,000 to $15,000. Secretary, G. S. Casselman, Finch Village.

Fisher and Herrick Townships, Ont.
The erection of a school is being considered. Secretary to the School Section, A. S. Chapman, Batchewan, Ont.

Fullerton and Downie Townships, Ont.
The Trustees of Union School Section No. 1, contemplate the erection of a school at an approximate cost of $4,800 Secretary, G. S. Thompson, St. Marys, R. R. No. 5.

Georgina Township, Ont.
The erection of a school is being considered by the Trustees of School Section No. 14. Estimated cost, $3,500 Secretary, E. G. Corner, Pefferlaw.

Goulburn Township, Ont.
The Trustees of School Section No. 10 are considering the erection of a school. Secretary, F. McCaffrey, Stanley's Corners.

Halowell Township, Ont.
The Trustees of School Sections Nos 6 and 12 are considering the erection of two schools. Secretaries, R. D. Milford, R. R. No. 1, Picton, and T. G Wright, R. R. No. 8, Picton, Ont.

Hamilton, Ont.
The General Hospital Board contemplate the erection of an administration building in connection with the Hospital Chairman, T. H. Pratt.

Iroquois Falls, Ont.
The construction of a school is contemplated. Secretary to the School Board, F. Lyons, Iroquois Falls

London, Ont.
The School Board are considering the erection of a technical school, a public school south of Dundas Street and east of Egerton Street, and additions and alterations to the suburban school at Ealing. Chairman, A. E. Silverwood.

The installation of a passenger elevator at the City Hall is contemplated. City Clerk, S. Baker.

The Board of Education are considering extensive improvements in the ventilation of several schools. Chairman, A. E. Silverwood.

Manvers Township, Ont.
The Trustees of School Section No. 1 are considering the erection of a school at an approximate cost of $3,000. Secretary, A. W. Hesslip, Janetville, R. R. No. 2.

Marlborough Township, Ont.
The erection of a school is being considered by the Trustees of School Section No. 4. Secretary, Henry Taylor, Malakoff.

Pictou, N.S.
The Pictou County Council are considering the erection of a new asylum near to the present one, which is becoming overcrowded. Treasurer, A. McDougall, Pictou.

Prevost Canton, Que.
The erection of a school at an estimated cost of $4,000 is contemplated. Secretary to the School Board, J. Lachance, St. Zenon P. O.

Renfrew, Ont.
The Department of Public Works, Ottawa, are considering the erection of an addition to the Post Office. Secretary, R. C. Desrochers, Ottawa.

Sharpe Township, Ont.
The erection of a school is contemplated by the Trustees of School Section No. 4, Marlborough. Secretary, Otti Stein, Costello.

South Marysburg Township, Ont.
The erection of schools is being considered by the Trustees of School Sections Nos. 13 and 15. Secretaries, J. W. MacAuley, Milford, Ont., and J. E. Murphy, South Bay, Ont.

St. Emile de Suffolk, Que.
The School Board contemplate the erection of a school at an approximate cost of $4,000. Secretary, A. D. Boivin, St. Emile de Suffolk.

Timmins, Ont.
The School Board contemplate the construction of a four-roomed school. Secretary, Adrien Allard, Timmins.

Tiny Township, Ont.
The Trustees of School Section No. 5 are considering the erection of a school, estimated to cost $4,000. Secretary, W. A. Casselman, Wyebridge.

Toronto, Ont.
The general contract for the erection of a temporary postal station has been awarded by the Dominion Government Department of Public Works to William Williamson, 131 Woodbine Avenue. Steel, galvanized iron and brick construction.

The Board of Education will receive tenders until January 28th for sundry work at the schools, including ash hoists, electric wiring, fire door, steam fittings and supply of drawing tables and side arm chairs. Specifications, etc., at office of the Building Superintendent.

Wellington, Ont.
The erection of a school is being considered by the Trustees of School Section No. 14, Hillier Township. Secretary, E. L. Hubbs, Wellington.

West Wawanosh Township, Ont.
Tenders will be called about the middle of February on the erection of a school for the Trustees of School Section No. 4. Plans are now at residence of the Secretary, W. McQuillan, R. R. No. 4, St. Helens P. O. Architect, A. Stuart, Lucknow. Estimated cost, $4,000.

Windsor, Ont.
Sub-tenders on trades required in the erection of an addition to the Collegiate Institute are being received by Schultz Bros. Company, Limited, Brantford, and John McLeod & Company, Limited, 110 Church Street, Toronto.

CONTRACTS AWARDED

Motherwell, Ont.
The School Board have let the following contracts for the school which is to be erected in the spring:—masonry, Brown & Sparks; carpentry, C. Kane; painting, W. Swan; plumbing, P. Warner; all in care of the Secretary, W. W. Rogers. Seating will be purchased later.

Business Buildings and Industrial Plants

Cape Breton, N.S.
The International Nickel Company, 43 Exchange Street, New York City, and Sudbury, Ont., have made arrangements with the Dominion Government for the establishment of a nickel refinery. President, Ambrose Monell.

Deseronto, Ont.
The Canadian Northern Railway Company, Toronto, contemplate the construction of cattle pens. Work will be done by the Company's Bridge & Building Department. Frame construction.

Galt, Ont.
The Canadian Cereal & Flour Mills Company, Limited, propose to add two storeys to their warehouse, and have applied for a permit. Secretary, R. C. Pratt.

Hamilton, Ont.
The Fire Chief, A. B. Ten Eyck, has recommended the erection of a fire hall in the southwestern section of the city.

Montreal, Que.
Work has been started by N. D. Leger, 2516 Chateaubriand Street, on the erection of a store and residence on Church Street. A number of trades will be sublet shortly.

Ottawa, Ont.
New tenders will be called shortly for alterations and additions to stores on Albert Street for J. G. Butterworth, 86 Sparks Street. Architect, W. H. George, Castle Building, Queen Street. Steel and brick construction, concrete foundation, felt and gravel roofing.

Tenders are now being received for alterations and additions to stores at O'Connor and Slater Streets for J. Brouse, 85 MacLaren Street. Architect, W. Herbert George, Castle Building, Queen Street. Brick construction, concrete foundation, felt and gravel roofing.

Port Arthur, Ont.
The Davidson & Smith Elevator Company propose to construct an additional storage with a capacity of 1,000,000 bushels. Particulars from J. R. Smith.

Quebec, Que.
Work will start in the spring on the construction of stock yards, etc., for the Quebec Abattoir Company, Limoilou. Day labor will probably be employed. Architect, A. H. Laberge, Beauport. Estimated cost, $35,000.

Sarnia, Ont.
Lockwood, Green & Company, Boston, are now negotiating with a view to the erection of a factory. Estimated cost, $500,000.

Tavistock, Ont.
The Dominion Railway Board Inspector will recommend the construction of a new station by the Grand Trunk Railway Company, Montreal.

Toronto, Ont.
R. T. Robinson, 131 Glenholme Avenue, has commenced the erection of a pair of stores at 754 St. Clair Avenue. The contract for plumbing has been let to E. F. Rockford, 880a Bloor Street W. Roofing, painting, plastering, wiring and heating not yet awarded.

Property Commissioner D. Chisholm has been instructed to report on the advisability of building three public lavatories, estimated to cost $9,800 each.

The Grand Trunk Railway Company have started work on repairs to the roof and top floors of the Union Station under the supervision of Engineer Mitchell, Department of Bridges and Buildings. Approximate cost, $10,000.

Witchall & Son, 156 St. Helens Avenue, are receiving sub-tenders in connection with the power station which is to be erected near Orillia.

Vancouver, B.C.
Tenders will be called about the end of the month for foundation work, piling and concreting in connection with the erection of a station for the Great Northern Railway, 90 Pender Street E. Architect, F. L. Townley, 850 Hastings Street W. Estimated cost of this work is $30,000.

CONTRACTS AWARDED

Hamilton, Ont.
The contract for plumbing required in connection with the warehouse which has been erected for M. Jax, 94 Cannon St. W., has been let to D. Robinson, 315 John Street N.

Montreal, Que.
The contract for electrical work required in connection with the stores and residences which are being built for J. Leclaire, 600 Demontigny Street, has been let to Raoul Chamberland, 825 Delorimier Avenue.

In connection with the factory which has been erected for the Steel Company of Canada, 1272 Notre Dame Street W., the contract for heating and ventilation has been let to the B. F. Sturtevant Company of Canada, New Birks Building, and the plumbing to T. O'Connell, 183 Ottawa Street.

In connection with the premises which are being erected at Bank and Sunnyside Streets for Graham Bros., 205 Laurier Avenue, the contract for heating and plumbing has been awarded to Gervin

& Lillico, 1095 Bank Street, and the electrical work to F. Presby, 138 Irving Ave.

Toronto, Ont.
The contract for masonry and stone work required in connection with the store and residence which is being built by J. P. Lever, 20 Atlas Avenue, has been awarded to the Granite Concrete Block Company, Limited, 1466 Yonge St.

Residences

Ailsa Craig, Ont.
The congregation of the Baptist Church are considering the erection of a parsonage, at an approximate cost of $5,000. Chairman of the Building Committee, S. Gillies.

Albertville, Ont.
William Woollatt, care of R. Wigle, Albertville, Kingsville, Ont., is considering the erection of a residence at an approximate cost of $3,500.

Beverley Township, Ont.
Hayward Cornell, R. R. No. 1, Troy, contemplates the erection of a residence. Brick construction, stone foundation.

Brockville, Ont.
Tenders will be received until February 7th for alterations to the residence of J. A. Mackay, Prescott Road. Architects, Barott, Blackader & Webster, New Birks Building, Montreal.

Hagersville, Ont.
Work will start early in the spring on the erection of two residences for Frank Tyrrel. Brick construction.

William Herod is considering the erection of a residence on King Street. Work may start in the spring.

Lakeside, Que.
The roofing required in connection with the residence in course of erection for C. W. MacLean is being done by day labor.

Montreal, Que.
Work has been started on the erection of four flats on Clark Street for H. Paiement, 1335 Gouin Boulevard. Brick construction, concrete foundation, felt and gravel roofing. Estimated cost, $20,000.

Niagara Falls, Ont.
William Hanover, Ferry Street, has commenced the erection of a residence on McRae Street, and contemplates building another on Armoury Avenue. Brick construction. Estimated cost, $3,000 each.

Ottawa, Ont.
Eugene Patry, 54 Irving Avenue, is about to start work on the erection of a residence, estimated to cost $3,500. Brick veneer construction, stone foundation, felt and gravel roofing.

Quebec, Que.
Work has been started by Leon Marcoux, 67 Napoleon Street, on the erection of a residence, estimated to cost $4,000. Frame and brick construction, stone foundation, felt and gravel roofing.

Ridgeville, Ont.
The erection of a residence is being considered by F. C. Williams. Work may start in the spring. Cement block construction.

CONTRACTS AWARDED

Ottawa, Ont.
The contract for heating and plumbing in connection with the residence which has been built by B. A. Grison, 21 Fentiman Avenue, has been awarded to Gervin & Lillico, 1095 Bank Street.

In connection with the residence which Walter Fryer, 5 Glen Avenue, has built on Roslyn Street, the contract for electrical work has been let to the Dominion Electric Construction Company, 417 Sparks Street.

In connection with the residence which is being built on Fentiman Avenue by F. Nunn, care of Ritchie & Nunn, 165 Sunnyside Avenue, the contract for heating has been let to J. Cameron, 488 Levis Street, the plumbing to J. P. Band, Bank Street, and the electrical work to H. L. Allan, 377 Somerset Street.

In connection with the residence which is being erected on Grove Street by John McCallum, 54 Glen Avenue, the contract for heating has been awarded to the Capital Hardware Company, Bank Street, and the plumbing to H. Knox, Elgin St. Painting by owner. Electrical work not let.

The following contracts have been let in connection with the residence which is being let in connection with the residence which is being built on Marlboro Avenue by Barrett Bros., 260 Catherine Street:—plastering, P. Beaupre, 13 Heney Street; painting, Bower Bros., 48 Aylmer Avenue; heating, John Stewart, Westboro; plumbing, J. T. Blythe, Frank Street.

In connection with the residence which is being erected on Fourth Avenue for A. Davidson, 69 Grosvenor Street, the contract for heating and plumbing has been awarded to Gervin & Lillico, 1093 Bank Street, and the electrical work to the Dominion Electric Construction Company, 477 Sparks Street.

Power Plants, Electricity and Telephones

Ailsa Craig, Ont.
William Hay contemplates the purchase of electrical machinery for operating his mill.

Amherstburg, Ont.
The Town Council are considering extensions to the existing lighting system and will later take up the question of installing a permanent lighting system. Clerk, G. E. Pulford.

Stamford Township, Ont.
The Township Council are considering the purchase of the electric plant of the Ontario Distributing Company and the erection of a sub-station at a total cost of $26,000. A by-law may be submitted to the ratepayers to authorize this expenditure. Estimated cost of sub-station, $3,000. Clerk, C. T. Monroe, Southend P. O.

Wellesley, Ont.
The Town Council will call for tenders within two months for the installation of a distribution plant. Estimated cost, $7,500.

CONTRACTS AWARDED

Montreal, Que.
In connection with the projected addition to the steam generating plant of the Montreal Tramways Company, 78 Craig Street, the contract for boilers has been awarded to Babcock & Wilcox, Limited, College Street, and for a turbo generator to the Canadian General Electric Company, Limited, 162 St. Antoine Street.

Fires

Amherst, N.S.
A business block owned by E. E. Hewson has been damaged by fire to the extent of about $4,000. Loss partially covered by insurance.

Birchcliffe, Ont.
The residence of A. F. Harris has been destroyed by fire. Loss, $2,000

Brandon, Man.
Fire has destroyed a store owned by Doig Rankin & Robertson Loss, $100,000.

Collingwood, Ont.
The store of Honeyford & Vernon has been damaged by fire to the extent of $15,000, including loss on stock. Some insurance is carried.

D'Israeli, Que.
Four residences have been destroyed by fire. Owners, John Gauthier, Severe Blanchard, J. A. Bengle, M. Levesue Loss, $10,000, covered by insurance.

Fairville, N.B.
Glendon H. Allen's drug store, the property of Robert Catherwood, has been destroyed by fire. Loss, $4,000, partially insured.

Fort William, Ont.
Fire has destroyed the music store on Arthur Street owned by J. R. Tucker.

A store at McTavish and McIntyre Streets, owned by Ignace Firlewrez, has been destroyed by fire. Loss, about $2,500, covered by insurance.

Galt, Ont.
Fire has destroyed the wooden grandstand in Dickson Park, owned by the Town Council. Loss, $5,000.

Hamilton, Ont.
The store of Kent Garvin & Company, 10 Catherine Street N., has been destroyed by fire. Loss on building and contents, $10,000.

Harriston, Ont.
The Town Hall has been destroyed by fire. The Town Council will rebuild. Clerk, A. J. Stewart.

Moncton, N.B.
Fire has damaged a building on Main Street owned by W. S. Smith, Main St

Montreal, Que.
The premises of the Canadian Architectural Iron Works Company have been entirely destroyed by fire.

Oil Springs, Ont.
Fire has destroyed the store of W. R. Wiggins. Loss, $5,000.

Fire has totally destroyed a store owned by Mrs. W. S. Duggan

Ottawa, Ont.
The residence of Alexander Abraham, 619 Booth Street, has been destroyed by fire. Loss, $2,500. Owner may rebuild

Quesnel, B.C.
Fire has destroyed the following pre-

(Continued on page 48)

Tenders and For Sale Department

Tenders Wanted

Tenders will be received by the Council of the Township of Hullett up to 2 p.m. on **Thursday, the 3rd of February, 1916**, for the erection of a steel bridge over the Walkerburn Creek, five miles north of Londesboro, the said bridge to be 60 ft. long and 16 ft. roadway, with cement floor and to be built on cement abutments. The lowest or any tender not necessarily accepted.

3-4 JAMES CAMPBELL, Clerk.

Tenders Wanted

Sealed tenders for all trades, with the exception of structural steel, in connection with the erection of the New Princess Theatre, Toronto, will be received until 5 p.m., **Saturday, February 12, 1916**, at the office of the undersigned.

Structural steel tenders will close at 5 p.m., Saturday, February 5, 1916.

Tenders to be submitted on forms to be supplied.

Plans and specifications may be seen at the office of Charles J. Read, Rooms 203-4 Confederation Life Building, Toronto, Ont.

C. HOWARD CRANE, Architect,
CHARLES J. READ, Associate Architect.
4-5-6

Separate sealed tenders, addressed to the undersigned, will be received at this office until 4 p.m., on **Tuesday, February 15, 1916**, for the supply of: "Brooms and Brushes," "Chain," "Coal," "Hardware," "Hose," "Oils and Greases," "Packing," "Paint and Paint Oils," "Manilla Rope," "Wire Rope" and "Steam Pipe, Valves and Fittings," for the requirements of the Departmental Dredging Plant in Ontario and Quebec during the fiscal year 1916-1917.

Each tender must be sent in a separate envelope and endorsed: "Tender for Hardware, Ontario and Quebec," "Tender for Chain, Ontario and Quebec," etc., etc., as the case may be.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures. These forms can be obtained at the Department of Public Works, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, for amount stated in form of tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the contract. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, January 21, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—90556. 4-5

AGENTS WANTED

Canadian sales agents wanted by large company manufacturing road making and contractors' machinery. Box 297, Contract Record and Engineering Review, Toronto, Ont. 4-7

For Sale

Large manufacturing company in the United States specializing in concrete machinery wants to sell outright a full set of drawings, patterns, and other information in reference to building and marketing concrete mixers. Good opportunity for Canadian manufacturer. Box 296, Contract Record and Engineering Review, Toronto, Ont. 4-6

Contractor's Plant For Sale

Two Ransom, 10 cubic feet capacity, Concrete Mixers, one equipped with loading skip, complete with steam engine.

One Beatty Hoisting Engine, single drum, double cylinder, 14 h.p., A1 condition.

One American Single Drum Hoisting Engine, single cylinder, 16 h.p.

Ten concrete carts, tools, etc.

Will dispose of at sacrifice price, and make terms of payment to suit purchaser. Apply Mr. Creed, Room 903, Read Building, Montreal. 3-4

WANTED

Two Mobile Switching Type Locomotives on rental, purchase basis, 16 x 24 inch cylinders, 4 or 6 wheels, with 3-inch tires, wheels not more than 44-in. center, sloping tender, capacity 2,500 gallons water and 4 tons coal, fitted with Westinghouse Brakes.

One Standard Gauge Contractors' Dinkey.

One ¾ Yard Revolving Shovel.

Box 298, Contract Record & Engineering Review, Toronto, Ont. 4-4

Concrete Mixers

Large company in Middle States making concrete mixers wants selling agents for Canadian territory. Good working arrangement and substantial assistance will be given to reliable aggressive agents. Box 279, Contract Record, Toronto, Ont. 1-4

Late News Items

Collingwood, Ont.
Plans for alterations to the waterworks system have been submitted to the Town Council by Consulting Engineer Willis Chipman, Mail Building, Toronto. They include the installation of an electric high lift pump and the construction of a water tower and pump well, complete with apparatus. Estimated cost, $19,000.

Cornwall, Ont.
The contract for electrical work required in connection with the warehouse which has been built for Canadian Cotton's Limited, 28 Victoria Street, Montreal, has been let to Goodwin's, Limited, St. Catherine Street West, Montreal.

Grand'Mere, Que.
The Town Council have let the contract for electric equipment to the Canadian General Electric Company, Limited, 162 St. Antoine Street, Montreal.

London, Ont.
Dennis H. Flannigan, 840 Lorne Avenue, intends to proceed with the stockyards scheme which was defeated recently by the Municipality. Plans will be prepared. Estimated cost, $7,000.

Smallman & Ingram Limited, Dundas Street, are considering extensive alterations to their premises. Architects, Watt & Blackwell, Bank of Toronto Building. Approximate cost, $20,000.

Montreal, Que.
Tenders will be received until January 31st for repairs to the grand stand at Blue Bonnets Race Track for the Montreal Jockey Club. Work includes foundations, masonry, concrete and architectural iron. Architect, R. E. Bostrom, 221 McGill Building.

F. Leduc, 314 Melrose Street, has commenced the erection of flats on Decarie Boulevard, estimated to cost $9,000. Subtenders are now being received on roofing, heating, plumbing and electrical work.

In connection with the flats which have been erected by Owen Roberts, 112 Addington Avenue, the contract for painting has been awarded to J. Cyr, 47 Lacasse Street, and the electrical work to the Ellwood Electric Company, 1830 St. Catherine Street E.

Outremont, Que.
The contract for roofing required at the cottage which has been erected on Hartland Avenue for R. J. Cornforth, 1720 Hutchison Street, has been let to Campbell, Gilday Company, Limited, 793 St. Paul Street, and the electrical work to the Electric Repair & Contracting Company, Limited, 317 Craig Street W.

Stanstead, Que.
The general contract for the erection of a registry office and municipal hall for the County Council has been awarded to Loomis, Dakin Limited, St. Gabriel Street, Sherbrooke, Que. Estimated cost, $10,000.

West Garafraxa Township, Ont.
Tenders on the erection of a residence will be received until February 1st by John Paton, R. R. No. 4, Fergus. Brick construction, stone foundation.

Sand should always be tested, according to Sanford E. Thompson in a paper on "Concrete Aggregates" presented before the International Engineering Congress. A table of results of actual tests showing variation in strength of mortars made with different sands compared to standard Ottawa sand is given in proof of this conclusion. The most satisfactory test is the determination of the strength of the mortar made up with the cement and fine aggregate to be used on the work in comparison with identical specimens made in the same proportions with standard sand.

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Vol. 30 February 2, 1916 No. 5

Principal Contents

The Aeration of Sewage

It is little more than a year since the treatment of sewage by forced aeration was announced in England. Yet several plants employing this method are already built, or under design by engineers, who feel that the experiments made justify their confidence. There are, however, a great many things yet to be investigated—such as the effect of relatively low temperature in winter on the process; how nitrogen in the sludge can best be built up; how much sludge will be formed under various conditions of operation, and whether a cycle or process of operation employing a series of tanks can be devised in such a manner that all of the easily reducible organics will be removed from both sewage and sludge; how much sludge will be available for the manufacture of fertilizer, and whether all that is of value may not be required for use in the continuous flow plan of sewage treatment to diminish the time of aeration to a minimum. Briefly, the process may be described as a reversal of the filtration method, in that the purifying medium is moved up and down through a tank of sewage, rather than the liquid moved through a bed of stone or gravel, each particle of which is surrounded by a film containing bacterial growths.

This method of sewage treatment has long engaged the attention of sanitarians, but only recently has it been sufficiently developed for adoption in a full-scale plant. One of the first experimental plants was completed and put in operation at Brooklyn on January 1, 1914. The first experiments carried on there were in a specially designed tank—called a tank aerator—built of wood, 12 ft. in diameter and 28 ft. 8 ins. deep, with a capacity of 16,000 gals. Compressed air was supplied by means of a pipe-grid placed at the bottom of the tank on a 7½ in. layer of broken stone passing a 2-in. ring. Over the grid is placed another similar layer of stone. The sewage enters at the top of the tank, through ports at the water-line, and the effluent is taken off by an outlet pipe at the botttom. The tank is equipped with peculiarly designed discs, which are intended to act as colloidors as well as deflectors of the flowing mass of sewage, and to give greater internal surface area within the sewage content for bacterial residence.

The result of a series of experiments proved that it is possible by this means alone, in a continuously flowing tank, without the employment of the activated sludge method, to produce a well-clarified and stable effluent, with a retention of 24 hours. Indications pointed to a possible shorter retention period, but the cost compared with that of the percolating filter seemed so unfavorable that at the close of the year 1914 the tank was changed over to an activated sludge tank. In order to proceed with activated sludge experiments it was only necessary to modify the aerator tank by introducing an outlet at about two-thirds of the depth of the tank, e.g., so that at each drawing 6,000 gals. of the settled sludge could be retained, discharging 10,000 gals. of clarified effluent.

Do not fail to read the article by Cosmo Hamilton on page 113 of this issue. "England's Malady" and the evils of the party system are portrayed in telling characters.

The importance of an experimental unit operating on the continuous flow plan was appreciated, and during the summer of 1915 three variations in designs for such a unit were tried out. All these designs were based on different modifications of the familiar settling or flowing-through chamber of an Imhoff tank, and gave a very good effluent. The work done so far on activated sludge does not justify positive conclusions, but offers considerable promise.

That Montreal Aqueduct

In the course of his address as president of the Montreal Board of Trade, on Jan. 26, Mr. G. F. Benson referred in the following terms to the controversy over the enlarged aqueduct: "I would particularly call your attention to the matter of the opposition of the Canadian Society of Civil Engineers to the present aqueduct scheme and the letter sent by our council to the Board of Commissioners. This is a question that

I think needs the very careful attention of your new council and of the members of this board. The statement is made that as a scheme for the development of power by the city, the enlargement of the aqueduct, as now proposed, is not an economic commercial proposition. It would seem to be leading to a cost of development that will greatly exceed that of any modern hydro-electric development, and the figures would indicate that it will result in a cost per horse power to the city higher even than the cost of development by steam power, and considerably higher than the present contract price that the city is now paying for electric power. The question also arises as to whether it is in any case wise to make the city dependent upon one source of hydro-electric power, in view of the well known troubles from frazil and back-water during the winter season, referred to in the letter addressed by your council to the Board of Commissioners."

Quebec Road Expenditures

Some particulars regarding expenditure on Quebec roads were given by the Hon. W. G. Mitchell, the Provincial Treasurer, during his speech on the Budget. The Government, he stated, was authorized to contract loans to the extent of $15,000,000, the proceeds to be expended in grants to municipalities to aid them in construction of roads under the provisions of the Good Roads Act and in the construction of Government roads, in accordance with the act. He also submitted the following statement:

Payments to municipalities to date.....	$ 8,162,574.43
Payments on Government roads to date	4,137,725.63
	$12,300,300.06
Net proceeds of loans	5,850,805.32
Excess of payments over proceeds of loans	6,449,494.74
Amount allocated to municipalities to date	$ 8,768,787.37
Amount paid on same	8,162,574.43
Balance to be paid	$ 606,212.94

A comparison between this statement and the similar one to 31st December, 1914, showed that during the calendar year 1915 there was paid to the municipalities the sum of $1,931,915.47, and expended on Government roads the sum of $1,957,956.35. It would also be seen that the amount that can hereafter be spent under the Good Roads Act is the difference between the $12,300,300.06 already spent and the amount of the proceeds of permanent loans for $15,000,000.00, which difference will probably not exceed $2,400,000.00.

Our Returned Soldiers

As the first result of the report recently issued by the Hospital Commission, a Soldiers' Aid Commission for Ontario has been established. The care of a soldier who has returned to Canada mutilated or weakened as a result of active service is the prime duty of Canadians. Each soldier is interviewed at Quebec on his return by a representative of the Canadian Patriotic Fund, and a confidential report is sent to the Patriotic Committee of the town to which the soldier is going. This serves the two-fold purpose of protecting the Fund against the greedy or unscrupulous and of giving the local committee information that is helpful in finding employment for the deserving. The Fund also presents a small badge bearing the words "For service at the front" to the deserving soldiers. Men wearing this badge are the worthiest citizens we can acknowledge.

The work of the Canadian Patriotic Fund is limited by Act of Parliament—no person in receipt of a gratuity or pension or allowance paid by His Majesty can receive assistance from the Fund. Because the pensions and gratuities are oft-times admittedly inadequate it has been found necessary to establish a Hospital Commission and Disablement Fund—the Soldiers' Aid Commission of Ontario is the first step in this direction. The latter has announced its intention of mobilizing manufacturers of Ontario, and we do not doubt that the process will be facilitated by the manufacturers themselves. Others also will be asked to lend their aid in discharging a great national duty, and there is every prospect that in Canada at least the traditional tragedy of the returned soldier will have no place.

1916 Officers Can. Soc. Civil Engineers

The complete list of new officers of the Society for the coming year is as follows: President, G. H. Duggan, vice-president and general manager, Dominion Bridge Company, Montreal; Vice-president, T. H. White, chief engineer, C. N. R., Vancouver; Councillors, J. R. W. Ambrose, chief engineer, Toronto Terminals Railway Company, Toronto; H. Donkin, deputy minister, Department of Works and Mines, Halifax; A. E. Doucet, Quebec; W. J. Francis, consulting engineer, Montreal; E. D. Lafleur, chief engineer, Department of Public Works of Canada, Ottawa; D. O. Lewis, district engineer, C. N. R., Victoria; D. A. Ross, consulting engineer, Winnipeg; H. R. Safford, chief engineer, G. T. R., Montreal.

Street Flooding Prevented by Wide Storm-Sewer Intakes

THE problem of handling large volumes of storm water in street gutters without flooding the crossing for pedestrians has been solved in Pasadena, Cal., by the use of long sewer intakes located in the curb adjacent to the street intersections. The intakes are made 30 ft. long, with a 9-in. opening. The sidewalk slab over the intake is of reinforced concrete, 3 ins. thick and supported at the curb line on two steel struts.

The normal flow line of the gutter is lowered 3 ins. and at the end of the intake away from the street intersection this difference in elevation is taken up in a length of 6 feet. At the crossing end, on the other hand, the gutter level is raised to within 2 ins. of the sidewalk level at the point where pedestrians cross. This affords a smooth intersection and a "high and dry" crossing, even in times of heavy storms.

The intakes were designed by R. V. Orbison, city engineer of Pasadena.—Engineering Record.

The latest revised Government report gives 376,303,600 bushels as the total yield of Canadian wheat in 1915. The average yield for all wheat (fall and spring) is 28.96 bushels per acre. The value of all field crops is placed roughly at eight hundred million dollars.

Erection Progress on Quebec Bridge

North anchor and cantilever arms completed — South anchor arm out to and including main post Work to be completed during 1916

By H. P. Borden*

WHEN work on the Quebec Bridge closed down a year ago, the north anchor arm was completed out to the main pier with the exception of two panels of the upper web members and top chord. On the south side no steel at all had been erected between the main and anchor piers.

About the middle of April a start was again made on the erection of the steel on the north shore, and on May 3rd the erection of the main posts was begun. These posts rest on the main shoes over the main pier and are the largest single members in the bridge, being 310 ft. high, centre to centre of pins, and approximately 10 feet square. As the four posts required for the bridge weigh approximately 6,000 tons, costing in the neighborhood of one million dollars, or considerably more than the entire cost of many important bridges, some idea of the magnitude of these members may be obtained. Each of these members is composed of four separate columns latticed together in four directions, terminated by a tapered solid section at both top and bottom. In order to facilitate shipment and handling, each of these members was shipped in twenty-six separate sections and spliced together in the field. It was expected that serious difficulty might be encountered in the erection of these sections as they had to be put in place with splice plates attached to the ends and lowered with extreme precision to allow the webs and flanges of the adjoining section to be entered between the various plates and angles forming the splice. The efficiency of the electrically controlled hoists on the erection traveler, however, was such that this work was carried out with remarkable rapidity, both posts on the north side being erected and sufficiently riveted to allow the traveler to be moved ahead within one month from the time a start was made. Sufficient riveting was done on these members to take care of all erection stresses before any further steel was erected or the traveler moved ahead. This riveting was considered highly advisable rather than filling the holes with bolts and drift pins and riveting later as the work progressed, as it was found from past experience that once a strain was applied to a drifted joint it was absolutely impossible to remove these drifts except by drilling. The cramped space in the interior of these members also made riveting somewhat difficult, but with the use of specially designed jam riveters, which could work in a space down to 14 inches, very satisfactory work was obtained. While in some cases the heads of inside rivets were not perfect, yet, in all cases, tight rivets were obtained.

When the erection of the main post had proceeded to the desired stage, the traveler was moved ahead and the erection of the first panel of the cantilever arm was started. As the bottom chords have a field splice between main panel points, it was necessary to devise some support for these members for riveting this splice before it could be connected to the main panel point. This was accomplished by means of a "flying bridge" or heavy steel platform extending for one full panel length and for the width of the bridge. On this "flying bridge," which was supported by links to the structure above, the bottom chords were assembled and jacked up into their proper alignment, and the centre splices fully riveted up. As each panel was completed the "flying bridge" was moved ahead to the next panel. This work went ahead very rapidly, as all field splices and connections had previously been reamed out in place at the shop, thus avoiding any shop errors or the necessity of making any alterations or changes in the field. As each panel was erected, accurate measurements were taken to see that the alignment was correct. Owing to the extreme accuracy with which this work was manufactured and inspected in the shop, no difficulty of this nature was encountered, the alignment of both the anchor and can-

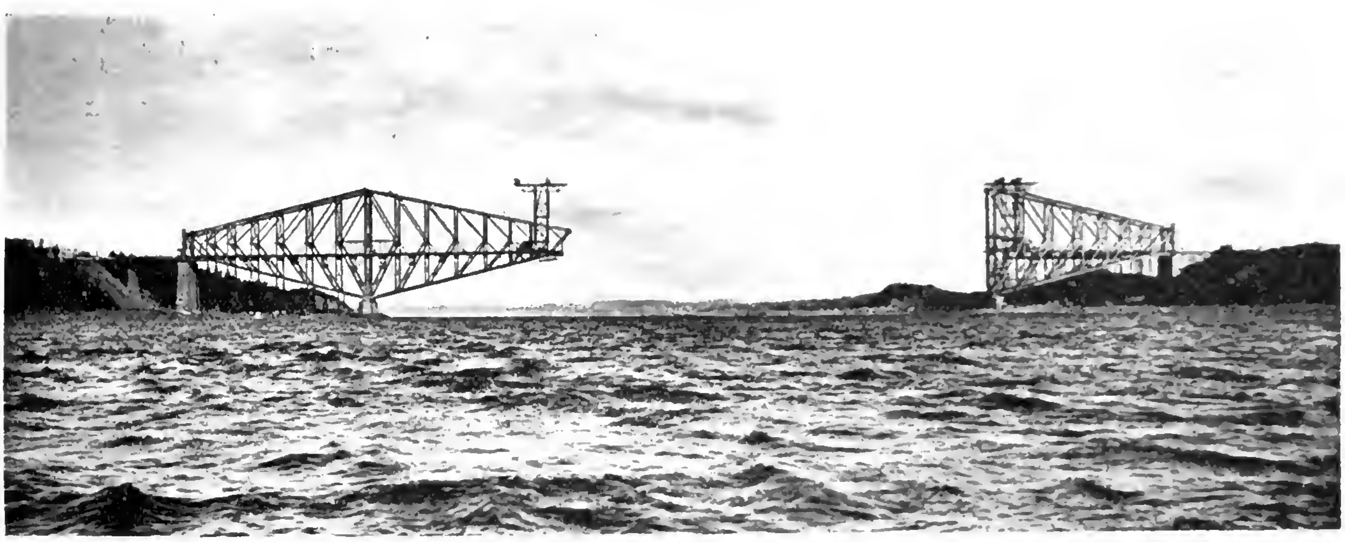


Fig. 1. General view of Quebec Bridge to date showing erection progress to the end of the season, 1915.

* Assistant to Chief Engineer—Quebec Bridge.

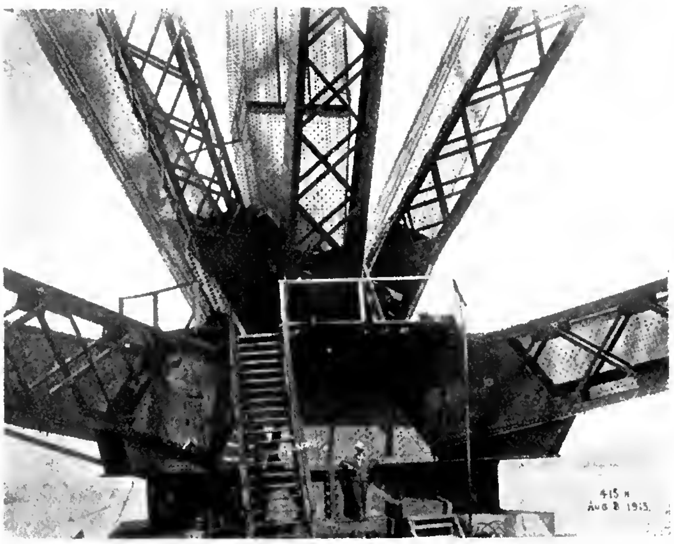


Fig. 2.—Intersection of ten members at the main shoe—Concentrated load on shoe about 55,000,000 lbs.

tilever arms throughout their entire length being absolutely correct.

Members on both sides of the bridge were erected simultaneously by the traveling cranes and stiff-leg booms, and as the traveler moved ahead the sway bracing was put in position by the rear booms. Practically all splices in web members were riveted up complete before moving ahead, or at least sufficiently riveted to carry the full erection stress. Remarkably good records were made in riveting, the percentage of rivets to be cut out being very low. In one case over 4,000 rivets were driven in the splices of the bottom chords, and only one loose rivet was found by the inspectors. This extraordinary record was due, naturally, to the experienced riveters employed on the work, but also to the fact that in reaming out the splices in the shop from 25 to 50 per cent. of bolts were used in bolting up the splice material, thus preventing drillings getting in between the web plates of the member. When the splice was taken apart, care was taken to clean out all drillings that might be found to exist between any parts of the splice material.

By the middle of November the cantilever arm was completely erected, being quite up to the progress laid out by the Bridge Company at the beginning of the season. The work of the traveler having been completed on this side of the river, it is now being taken down and will be re-erected at the site where the suspended span will be erected next year. On the south shore the erection of the falsework to support the anchor arm was started about the middle of April, this falsework being taken from the north shore where it

Fig. 3.—Panel point of bottom chord showing unusual dimensions of members—pneumatic bucker-up, hammer and rivet cutter at work.

had been used to support the north anchor arm. The erection of the anchor arm started on July 7th, and, owing to the experience gained on the north side, was erected much more rapidly, a gain of over six weeks being made in the completion of this work. By the middle of November the entire anchor arm had been erected, including the main posts, with the exception of a certain amount of riveting, which will be completed next year.

During the past season about 30,000 tons of steel

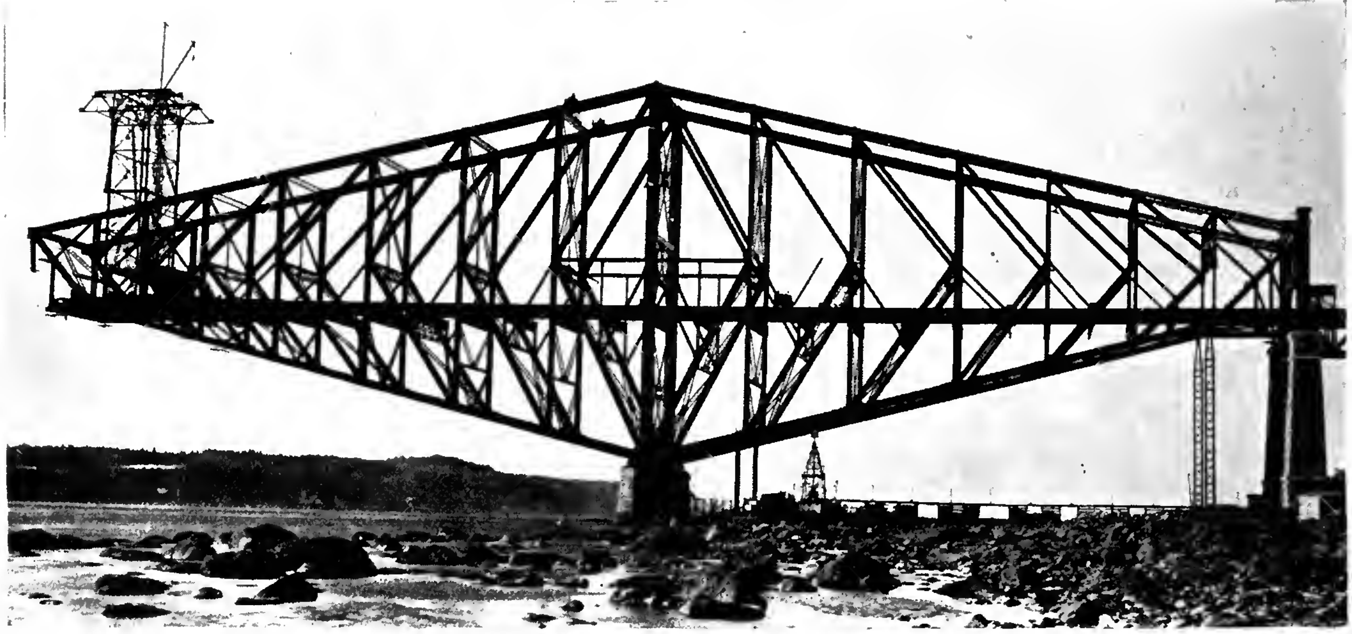


Fig. 4.—Completed north anchor and cantilever arm—Traveller being taken down to be used in the erection of the suspendspan.

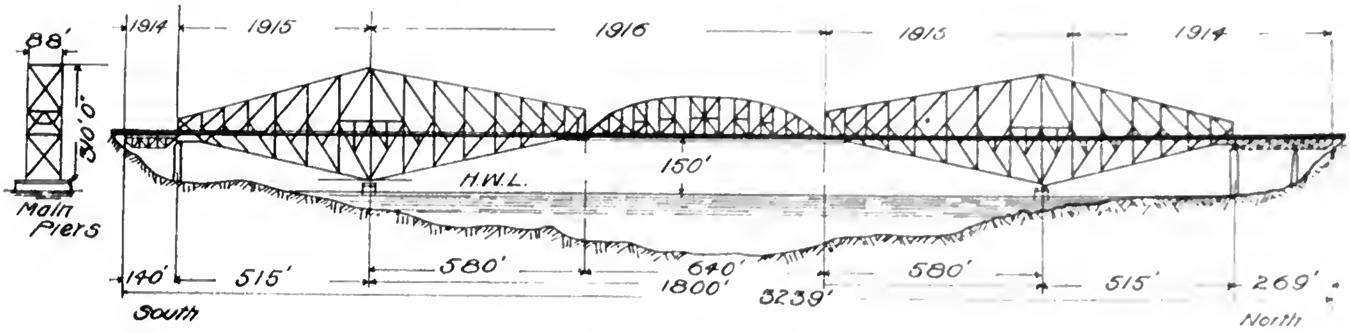


Fig. 5.—Quebec Bridge Progress—shows work done in 1914, 1915 and program for 1916.

was erected. In all about 45,000 tons has been erected out of the 65,000 tons, the estimated total weight of the bridge. The record day's tonnage in 1915 was 670 tons for the south shore traveler, although there were several days in which over 600 tons was erected by this traveler. An average of 350 tons per day was made in the erection of the south main post.

Next season the south cantilever arm will be erected, and it is expected that this work will be finished early in September. The suspended span will also be erected at Sillery Cove, a point some three miles below the bridge site. When completed it will be floated to the site on six pontoons 160 ft. long and 32 ft. wide, each having a working draft of 8 feet. This span, which is 640 ft. long, 110 ft. high at the centre, 88 ft. wide, and weighing about 5,000 tons, will then be attached to long hangers from the ends of the cantilever arms and jacked into place by means of heavy jacks placed on the erection girders at each corner of the cantilever arm. This operation should not take over twenty-four hours if everything works smoothly. By the end of 1915 practically all the steelwork of this bridge should be in place, and it will be possible for working trains to cross the river at this point.

The work is under the supervision of the Board of Engineers, Quebec Bridge, composed of C. N. Monsarrat (Chairman and Chief Engineer) and Ralph Modjeski; (Mr. C. C. Schneider, late member, deceased).

The contract is being carried out by the St. Lawrence Bridge Company, Limited, of which Geo. F. Porter is Engineer of Construction, W. B. Fortune, Superintendent, and S. P. Mitchell, Consulting Engineer of Erection.

The Aeration or Activation of Sewage

New method of sewage treatment sufficiently developed for adoption in full-sized plants—Experimental work at Brooklyn, N.Y., increases confidence in this system.

By G. T. Hammond*

The treatment of sewage by forced aeration, in the presence of activated sludge, is one of the most interesting developments in sanitary disposal methods of recent years. It is but little more than a year since the process was announced in England. Very extensive and careful study has already been given the subject, and numerous papers have appeared concerning it. At the present time, several full-size plants employing this method are building or under design by engineers who feel that what has already been learned about it experimentally justifies their confidence. There are, however, a great many things about it that are unknown, and all admit that much remains to be investigated, either in testing stations at a relatively small expense, or in full-size plants at possibly a larger cost, in order that we may obtain a satisfactory understanding of the many problems that have already presented themselves as to the nature of the phenomena and underlying principles of the method, and as to the essential features of the design of plants and apparatus for its employment.

Some of the problems that are engaging the attention of investigators are the effect of relatively low temperature in winter on the process; how the nitrogen in the sludge can best be built up; how much sludge will be formed under various conditions of operation, and whether a cycle or process of operation employing a series of tanks can be devised in such manner that all of the easily reducible organics will be removed from both sewage and sludge; how much sludge will be available for the manufacture of fertilizer, and whether all that is of value may not be required for use in the continuous flow plan of sewage treatment to diminish the time of aeration to a minimum.

Point of Equilibrium

There is probably a condition of equilibrium to be secured in the treatment under which just about so much sludge will be used by the process to obtain a required result, and just about such a surplus will have to be disposed of. How to adjust the method to the varying strength and quantity of the sewage as it flows to the plant, and the effect of varying strength of sewage on the expense of the treatment, also requires much study.

The efficiency of the method in regular service under the ordinary operation conditions that prevail in all American cities, its cost and economy, and its reliability as compared with other methods of sewage treatment now well known and giving good and cheap service, cannot but engage the careful study of conservative men, whose object usually is to provide the most economical method of treatment which shall offer the greatest promise of efficiency and reliability under existing requirements and circumstances.

Much remains to be learned of the new method

* Presented before section D of the American Association for the Advancement of Science at the Columbus Meeting December 29th, 1915.

along these lines; and while to the scientist investigating it in the experiment plant it seems so promising, a word of caution should be given to the engineer charged at present with designing a sewage treatment plant. Judgment should remain suspended until more definite information is available on the points above mentioned.

Fuller has characterized the process as in a sense a reversal of the filtration method, in that the purifying medium is moved up and down through a tank of sewage, rather than the liquid moved through a bed of stone, each particle of which is surrounded with films containing bacterial growths and their products, all of suitable physical and biological character.

Forced Aeration Process

Wilkinson of Manchester, England, without going into the details of sludge formation, gives about the most concise yet adequate picture, from the engineer's standpoint, of the process, "stripping the theory of all scientific verbiage and putting it in its naked simplicity." We quote, as follows:—

"First of all, in modern plants sewage is usually treated in a percolating filter, by spreading it evenly over the surface, and allowing it to pass through the material to the main under-drainage system. The liquid, in passing through the filter, flows over the surface of the medium, and the more vesicular the character of the latter the better. On starting up a new filter, the sewage shows but little change after passing through, but as time goes on, a growth shows itself in the body of the filter on what may be termed the stationary frame-work, and colonies of bacteria accumulate there, which attack the sewage and effect purification or oxidization of the organic matter.

"These bacteria, being mainly aerobic, an ample supply of air is necessary in order that they may thrive; hence the necessity for adequate ventilation of the under-drainage. That, in brief, is the theory of this, as it appears to an engineer. Let us take a given volume of the stationary frame-work from a ripe filter and carefully remove the coating or growth throughout the material. We shall then have a certain volume of what may be termed sludge, rich in aerobic bacteria, which may be referred to as the activated sludge of this particular process.

Sludge Circulated

"In the new process the active sludge is circulated throughout the sewage in the presence of air, as against the present-day practice of passing sewage in thin films over active sludge retained on a stationary frame-work, as in the case of percolators, for example.

"The real problem, then, is as follows: To ascertain the most economical method of applying air to sewage, with maintenance of complete circulation of the activated sludge without any formation of dead banks of material.

"The problem may now be said to resolve itself into one of reproducing in a tank the changes which take place in a percolating filter. We have our tank, which represents the walls and floor of the filter. We have our colonies of bacteria and the air necessary to support their life, and all we require to do is to provide means for supporting an even distribution of this life throughout the body of the tank, other than by allowing the bacteria to adhere to a stationary framework, such as stone, slate, or clinker material. Compressed air will both insure sufficient agitation and effect the desired results as regards preserving uniform contact and even distribution in the liquid. But at what cost?"

A successful method of sewage treatment by forced aeration has long been an object sought by sanitarians. Observation of the phenomena of the purification which takes place in flowing streams and in foul water in the presence of abundant air, indicated that an intensive method of supplying the oxygen demands and of cultivating bacteria for the purpose of securing a more rapid nitrification, should be possible. But Dibdin tried forced aeration in 1884 and failed with it. In 1890, Dr. Brown and Prof. Leeds of this country, after experimenting, concluded that the oxidation of organic matters in sewage is not facilitated, to any appreciable extent, by forced aeration. In 1894, Col. George E. Waring, Jr., employed forced aeration in a filter with some good effect. After this, nothing of interest is recorded until the matter was taken up in Brooklyn, N.Y., in 1910-11; by Col. William M. Black, U.S.A., and Prof. Earle B. Phelps, who found it possible, by methods designed by them, to reduce the oxygen demand of the sewage one-half to two-thirds, under varying conditions, by applying about two volumes of air per volume of sewage, in a retention period of three hours, although the apparatus was crude and the conditions rather unfavorable. At about the time that the report of these experiments was published, or soon afterwards, the Massachusetts State Board of Health, at the Lawrence experiment station, began experimenting along the same lines, although on a smaller scale in the size of units employed; and in 1913 introduced layers of slate in their aerating tank, by which they secured a very high removal of suspended and coloidal matters and greatly reduced putrescibility. During this work in 1912 at Lawrence, some experiments were made in aerating sewage in bottles, without any contained medium for surface growths other than the inside of the bottle itself. These were seen by Dr. Gilbert Fowler of Manchester, during his American visit of that year, and interested him so much that on his return home he utilized the suggestions and extended the investigation, and the Activated Sludge process resulted.

While the results obtained in Brooklyn previous to 1912 offered much promise, it was not considered that the method was sufficiently developed for adoption in a full scale plant for sewage treatment, and the authorization of funds for installing a sewage experiment plant in Brooklyn, at the very location where Messrs. Black and Phelps have done their work, gave the opportunity in 1913 to include apparatus specially designed to carry their work to a conclusion. The experiment plant was completed and put in service on January 1, 1914, since which time sewage-aeration experiments have been carried on, except in extremely cold weather.

Experimental Plant

The original apparatus did not include special provision for activated sludge experiments, as this method was not announced until the fall of 1914, when this plant had already been in operation nearly a year. The sewage aeration work, however, was provided for, and but slight change in it was necessary to adapt it to the new method in the spring of 1915.

The first series of experiments in sewage aeration were carried on in a tank of special plan, denominated the Tank Aerator. This was designed with the intention of giving a considerable interval surface area for the adherence of bacterial growths, as suggested by Prof. Phelps, and at the same time effecting an even and complete application of the air forced into the tank to the sewage contents thereof.

The result of the series proved beyond question that it is possible by this means alone, in a continuously flowing tank, without the employment of the activated sludge method, to produce a well clarified and stable effluent with the application of 18 volumes of air per volume of sewage, with a retention period of 24 hours. There were indications that this period of retention could be materially shortened, but the cost of the process in comparison with that of the percolating filter, seemed so unfavorable that, after the close of 1914, the tank was changed over to an activated sludge tank.

Tank Aerator

The Tank Aerator is built of wood, 12 feet in diameter and 28 ft. 8 ins. deep. The effective sewage capacity is 16,000 gallons. The compressed air is supplied by means of a pipe-grid, placed at the bottom of the tank, formed of 1½ in. pipe placed at right angles, forming a cross, connected in the center, the arms of the cross being connected with five quarter-circles of ¾ in. pipe, forming concentric rings, each being perforated with 1-16 in. holes at 6 in. intervals. The air enters through the 1½ in. cross pipes and is thence distributed to the rings.

This entire grid is placed on a bed 7½ in. thick, of broken stone passing a 2 in. ring. A layer of broken stone, of the same size and thickness as bed, is placed over the grid. The grid has a connection with the city's water service for use in cleaning it out under pressure.

This method of air distribution has proved very satisfactory, practically no clogging having occurred in two years of service, and the average distribution of air has been very good.

The sewage enters at the top of the tank through eight ports at the water line, each supplied from a pipe which encircles the tank, and, as originally built, the effluent is taken off by four outlets into a common outlet pipe at the bottom.

This tank is equipped with a peculiar design of discs, which are intended to act as colloidors as well as deflectors of the flowing mass of sewage, and to give greater internal surface area within the sewage content for bacterial residence.

There are nine of these discs, all supported by means of a vertical 4 in. pipe placed in the center of the tank. In form, these discs are not unlike wheels. The supporting pipe passes through their hubs. The surface of each is formed of slats about 4 in. wide, spaced one inch apart, with surfaces set 45 degrees with the vertical. The angular surface of the slats towards the center is alternated in direction in each succeeding disc.

Each disc is placed horizontally and occupies the entire cross-section of tank, which is thus divided into a number of compartments, through which the vertical currents of sewage are regulated and streaming prevented, either of sewage passing downward or air passing upward.

Continuous Flow Experiments

The first continuous flow experiments in this tank were not considered at the time as very encouraging. An air supply 0.75 volume per volume of sewage, with 2 hrs. retention, being insufficient to produce any marked improvement over the crude sewage, except a slight dimination in oxygen demand, and some clarification; but our expectations were too high. Continuous flow experiments were therefore suspended for a time and, with the object of ripening the interior surfaces of the tank, the latter was filled with sewage, and beginning on the fill and draw plan, May 19, 1914, air was passed through the sewage for long periods of time, until complete clarification occurred. The contents on settling now showed a high degree of stability. Some of the phenomena of activated sludge were observed, but the desirability of saving the latter was not recognized.

On June 14th, the continuous flow was again employed, with a retention period of 5 hrs., and the application of 3.25 volumes of air per volume of sewage. This failing to give a satisfactory result, the retention period was increased on July 10, to 24 hrs., 18 volumes of air per volume of sewage being used, with marked result. The effluent, after 3 hrs. retention in a secondary settling tank, showed a quality comparable favorably with the settled effluent from a percolating filter. This experiment was carried on until October 1, 1914, when the air was reduced to one-half, or nine volumes per volume of sewage treated, the continuous flow plan being maintained, and the retention period being 24 hours. With 18 volumes of air per volume of sewage from July to October, the settling tank effluent kept improving, the relative stability average being 84 per cent. stable. After the air was reduced to 9 volumes per volume of sewage, the relative stability of the settled effluent fell to 59 per cent.

Contact Aerator

Some interesting results were obtained from an aerated contact filter, on contact aerator, during this same period. This was a small unit operated on the fill and draw plan, suggested by a visit to the Lawrence experiment station early in the spring of 1914.

A tank was seen at Lawrence about 3 ft. by 4 ft. in plan and 2 ft. deep, in which slabs of thin slate were suspended vertically about one inch apart, in which the sewage was treated by compressed air, a circulation of the sewage being secured between the slabs by an ingenious arrangement of the air inlet. The results achieved seemed remarkably good and seemed to us to be largely due to the extensive area that the slates afforded for bacterial residence and for the absorption of coloids. Our thought was that as good if not better result might be obtained in an aerated contact filter bed which would be less costly to instal on a large scale. To make a preliminary experimental test, a small unit was devised, which was filled with broken stone, passing a 2 inch and rejected by a 1 inch ring. The stone bed was 30 inches in depth. The voids afforded a capacity of 20 gallons, compressed air was applied at the bottom. The sewage entered at the top and was discharged at the bottom.

Experiments with this unit extended from May 6th to July 6th, 1914. The average results were as follows:

	Hours Aeration.			
(Sewage 20 gals. at each filling.)	0	2	5	24
Air 0.17 cu. ft. per minute				
Dissolved Oxygen	1.9	1.4	2.5	2.2
Relative stability	2	4	44	79
Dissolved Oxygen demand	252	134	80	68
Air, 0.35 Cu. ft. per minute				
Dissolved Oxygen	2.5	3.7	5.0	7.2

Relative stability	3	13	75	92
Dissolved Oxygen demand	248	92	68	64
Air, 0.64 cu. ft. per minute				
Dissolved Oxygen	1.1	4.9	6.4	6.8
Relative stability	2	62	100	100
Dissolved Oxygen demand	246	62	50	33

During the work of 1914, we did not recognize the activated sludge principle, and it was not until the late fall, when we learned of the work of Dr. Fowler and others, that we began to take it into account and think that probably it had played a considerable part in our aeration results, especially in the work of the contact aerator. By this time the season was so far advanced that we put off work along the new lines suggested until the spring of 1915.

Aerator Tank Modified

In order to proceed with activated sludge experiments, it was only necessary to modify our aerator tank by introducing an outlet at two-thirds of the depth of the tank, so that at each drawing we could retain 6,000 gallons of the settled sludge, discharging 10,000 gallons of clarified effluent.

The operation of this tank as an activated sludge tank began in the middle of March, 1915. Several weeks were required to accumulate a working quantity of the active sludge. The tank was operated on the fill and draw plan. By May 1st, the results with 24 hours aeration showed excellently.

Regular operation was commenced June 1st, on the following cycle:

8 a.m.—Shut off air from tank; allow activated sewage to settle one hour.

9 a.m.—Commence drawing of effluent, taking off 10,000 gallons.

10:30 a.m.—Drawing completed; air turned on; crude sewage valve opened.

12 m.—Tank filled, crude sewage valve closed; air continued on until 8 a.m. of following day.

This cycle was continued from the beginning until the recent shutting down of the tank to make changes in the plant for extending the experiments along new lines.

One of the objects in view was to obtain a considerable range in the effect of time and quantity of air, and the cost. Another was the desirability of having on hand a reservoir of activated sludge to draw from other experiments, especially for the continuous flow tank to be mentioned later on.

The results of an average month's operation in the summer are exhibited below:—

Hours Aeration After Refilling Tank

Refill—	0	2	5	20
Volumes of air per vol. of sewage	1.17	3.50	7.00	24.55
Dissolved Oxygen p.p.m.	0	0.1	0.4	2.5
Relative Stability per cent.	15	38	62	100
Oxygen demand, p.p.m.	56	42	..	8
Suspended solids	35	24	20	14
Nitrogen as Nitrites	0.08	0.11	0.49	1.5
Nitrogen as Nitrates	0.1	0.6	1.2	7.3

The sewage averaged—Dissolved Oxygen P.P.M. 1.0; Relative Stability, 3 per cent.; Oxygen Demand (biologic) P.P.M. 200; Nitrogen as Nitrites and Nitrates, a trace only.

The importance of an experimental unit operating on the continuous flow plan was appreciated, and during the summer three variations in designs for such a unit were tried out, the purpose being for experimental uses rather than to devise a tank for use in a large plant; for it was apparent from the first that the method would probably require a series of tanks for actual sewage disposal work on a full scale; but it was desired to study the phenomena of the continuous flow without interfering with the aerator tank and without disturbing other experimntal work. A tank holding about 1,000 gallons, located directly at the side of the aerator tank, was available for this purpose, and result rather tends to indicate that a continuous flow operation can be secured from a single tank if this should be found necessary.

The small tank in question was, in the clear, 54 inches in diameter and 8 feet deep from the water line. The bottom was of hopper shape. The air was supplied by means of five carborundum discs, all carefully placed at equal level. The top of the tank was successively provided with three different designs of clear effluent chambers for quieting the flow passing out and cutting it off from the air agitation in the body of the tank itself, so that the activated sludge could settle out and fall back into the tank, permitting the quiescent clear effluent to pass off continuously.

All of these designs were based on different modifications of the familiar settling, or "flowing through" chamber of an Imhoff tank, and gave a very good effluent.

The clear effluent chamber in each modification was of about one-tenth the capacity of the tank, giving about one hour's retention when run as below described.

Tank Charge

This tank was charged directly from the large tank with fully ripe activated sludge on July 14th, and crude sewage was admitted at the rate of one-tenth the tank capacity per hour. Air was supplied at the rate of 0.7 cu. ft. per minute. A well clarified effluent was secured, the oxygen demand averaging 27 P.P.M., which would be good enough for our local water ways, especially as the effluent is practically free from suspended settleable solids.

On August 12th, the operation was changed to a retention period of 8 hrs. and 45 mins. passage through the aeration chamber, and 45 mins. sedimentation in the clear effluent chamber. For the first week the result was very gratifying. The effluent was highly clarified, and its demand for oxygen was low, but there was almost a complete absence of dissolved oxygen and nitrates, which rendered the stability low, though the separated effluent continued good.

The tank was then emptied and refilled with a fresh charge of thoroughly activated sludge from the large tank, and the retention reduced to 4½ hrs. aeration and 23 mins. sedimentation. This gave a fair effluent and good clarification; but the result soon became imperfect again, indicating that while thoroughly activated sludge will settle very quickly, it takes a longer time if the activation is imperfect, on account of too short a retention period in the aerating tank.

Preliminary contracts have been awarded in connection with the power plant extensions of the Montreal Tramways Company. It is announced that the contract for boilers has been let to Babcock & Wilcox, Limited, and for a turbo generator to the Canadian General Electric Company.

New Curry Block, Winnipeg, Man.

Reinforced concrete store and office building—To be ultimately ten storeys high—Sets a time record in building Cost to date $250,000

The new Curry Building recently erected at the corner of Portage Avenue, Notre Dame Avenue and Garry Street, Winnipeg, at a cost of $250,000 set a record for this size of reinforced concrete building in Western Canada, being built, complete for occupation, in five months. The building is 266 feet by 130 feet, and, including the basement, is three storeys high. It is built of reinforced concrete, with an exterior finish of terra-cotta backed by plain brick.

The main entrance on Portage Avenue is finished in white marble, with a large revolving door of mahogany; the side entrances and corridors are also white marble, with the interior finish of quarter-cut oak on the ground floor, and mahogany on the upper floor. The foundations of the building are constructed to carry ten storeys, which will be the ultimate height of the building. The ground floor, which is 19 feet high, contains twenty stores, while the upper storey is divided into thirty-nine offices. Freight and passenger elevators provide good accommodation.

The building is steam-heated and modernly ventilated and lighted. Under the front sidewalk is a transformer vault into which both central station companies bring their 2200-vault, single-phase primaries and transform it down for 110-220 volt distribution, each company delivering half the required load. A duplicate set of automatic double-throw switches ensures continuity of service in case of service interruption to either company. A complete system of metering keeps accurate account of the power delivered to the different tenants by each company. Each store is provided with a separate panel in the basement, so that show-windows and signs can be separately metered. Corridor fixtures consist of ventilated bowls with high-efficiency Tungsten lamps, while the office fixtures, lamps with shades, provide a maximum lighting value of 8-foot candles, the store capacity, however, is considerably greater. A complete telephone system is also installed.

The illustration Fig. 2 shows a test being made on a reinforced concrete panel slab in the above building. The slab is 16 feet by 17 feet, and was subjected to a load of 70,000 lbs., equivalent to 250 lbs. per square foot. Under this load the slab was deflected three

Fig. 2—Concrete test. Curry Building, Winnipeg, Man

sixteenths of an inch, but returned to its original position when the load was removed. The test was made when the concrete was two months old: pig iron, cement, and stone being used to make up the load on the slab.

The building was designed by J. D. Atcheson & Company, architects, and constructed by the Sutherland Construction Company.

An interesting little booklet has just come to hand from the pen of W. P. Gerhard, C. E., 30 East 42nd Street, New York City, on the subject "The Water Supply of Country Houses."

Fig. 1 New Curry Block, Winnipeg, Man.

A Hollow Concrete Storage Dam

Comprises the equipment for a water storage and regulation scheme for the St. Francis River, P. Q.

The water-storage and regulation scheme proposed by the Quebec Streams Commission for the St. Francis River in the Province of Quebec has been described in some detail in earlier issues of the Contract Record. Contract for the storage dam has recently been let to Madden & Co., of Quebec, for $101,000. The following further notes are taken from a recent issue of "Engineering News."

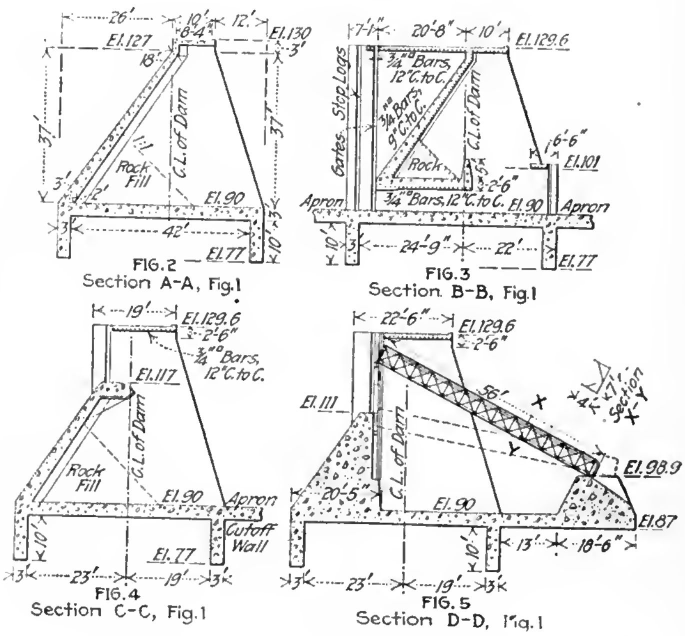
The regulation scheme briefly comprises a large storage dam at the outlet of Lake St. Francis and the purchase of about 4 sq. mi. of land to be flooded and power rights now held by individuals on Lake St. Francis and Lake Aylmer (just below). By raising the water level of Lake St. Francis 27 ft. the storage capacity will be increased by 438 sq. mi.-ft., making it feasible to regulate for a constant discharge of 600 sec. ft., which is an increase of 500 sec.-ft. over the present minimum.

The total fall along the river is about 900 ft., so that about 41,000 hp.-yr. additional is possible; but only 200 ft. available head is now utilized, so that the increase of power from the scheme will be about 6,000 hp.-yr. The present power users will be charged a sum per horsepower of increased capacity sufficient to cover the investment and maintenance of the storage scheme.

The dam itself, some typical sections of which are shown in the accompanying sketches, is to be of a hollow type, with reinforced floor slabs supporting a series of buttresses, which in turn on the upstream side carry a deck slab, flat on the outside face and arched on the inside (15-ft. radius). The buttresses also carry a concrete roadway.

The buttresses are 5 ft. thick and are on 20-ft. centres generally. In the gate section the buttress faces are vertical and have stop-log and gate grooves, as shown in Fig. 2. At the log sluice also the buttresses have a vertical face and show stop-log and log-slide grooves. The deck is carried on seats. The deck slab has the slope of the buttress faces, except for a vertical top section. At the log sluice a solid wall replaces the deck slab, as shown in the section, Fig. 5.

The floor slab varies in thickness from 15 to 36 in. The reinforcement is of ¾-in. square twisted steel bars bent so as to be 3 in. above the bottom of the slab at buttresses and 3 in. below the top of the floor between buttresses. The inner corner between the deck and floor will be filled with rock and faced with mortar. The two cutoff walls will be 3 ft. thick and 10 ft. high. At tht end panels they are joined and run as a bulkhead into the banks. Cutoff walls and

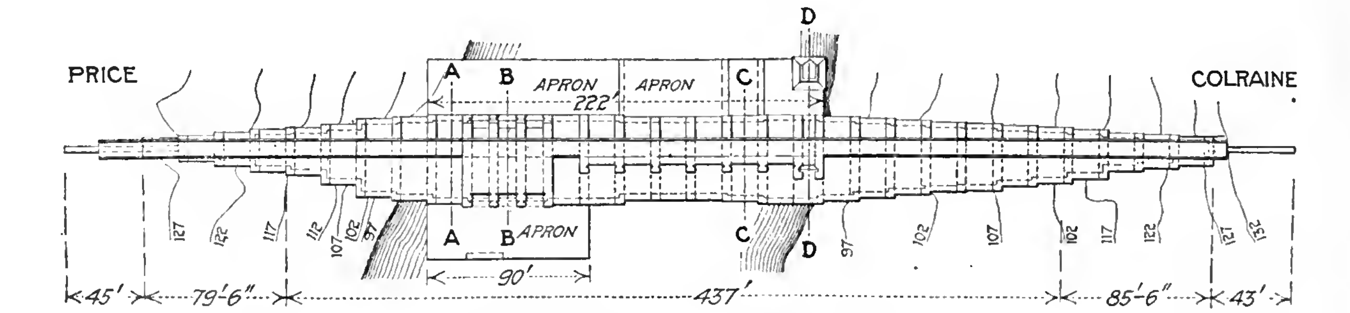


Sectional Elevations—show method of construction of hollow dam.

floor are monolithic. For floors, buttresses, aprons, etc., the concrete will be a 1:2½:5 mix, and for the deck slab and arches a 1:2:4 mix.

The Ottawa branch of the Canadian Society of Civil Engineers have made arrangements with the officers of No. 3 Field Company, Canadian Engineers, whereby members of the former branch may attend the lectures and drills of the latter. A special committee on military engineering has been appointed, consisting of the following members: W. S. Lawson (chairman), R. de B. Corriveau, G. G. Gale, Alex. Gray, and J. B. Challies.

The Warren Brothers Company, of Boston, Mass., have issued an attractive booklet dealing with Warren's portable asphalt plant; well illustrated.



Plan of Concrete Storage Dam at Lake St. Francis, P. Q.

Can. Soc. Civil Engineers Convene

30th Convention of Canadian Engineers at Montreal—Valuable Reports Received on Portland Cement, Bridge Specifications, Roads and Pavements, &c.—An Open Discussion on the Advisability of Extending and Enlarging the Scope of the Society to Include Every Section of the Dominion

The annual meeting of the Canadian Society of Civil Engineers, held at the Society's headquarters, Mansfield Street, Montreal, from January 25 to 28, was largely attended. Mr. F. C. Gamble, the president, was in the chair.

At the first session, held on Tuesday morning, the minutes of the last meeting were read and confirmed. This over, Mr. G. R. G. Conway proposed the following resolution which was received with the utmost cordiality, and which was carried unanimously amid repeated cheers:

> "That this meeting extends to Sir John Kennedy, past president; Sir Collingwood Schreiber, honorary member, and Sir Alexander Bertram, member, its heartiest congratulations upon the Order of Knighthood recently conferred upon them by his Majesty the King. The Society also wishes to place upon record its appreciation of the Royal and public recognition the engineering profession has received by the honors placed upon our distinguished members, who have always maintained the highest ideals of our profession. We recognize in the bestowal of these honors the growing public recognition of the engineers' influence not only in the arts of peace but also in the great ordeal the Empire is passing through at the present time."

Sir John Kennedy acknowledged the resolution on behalf of himself and the other recipients of the honors, stating that he looked upon the honors as a recognition of the engineering profession.

The President announced the receipt of the following cable, dated London, from General Armstrong, chief engineer of the Canadian Army Corps: "Please thank members for generous contribution Engineers hospital Fund. Greetings from all members serving Canadian Engineers to comrades at meeting." A reply was sent as follows: "Heartiest good wishes to all members at the front in defence of the Empire. May you speedily return to us victorious."

Annual Report

The report of the council was next considered. This showed that during the year there had been added to the roll 14 members, 66 associate members, 2 associates, 23 juniors, and 42 students—so that the total membership now stands 3,076. Twelve members of the society have been killed in action in France. The report also spoke of the very satisfactory progress made in connection with the opening of branches of the society, the last of which was formed at Regina under the present chairmanship of Mr. O. W. Smith. In July last a branch was organized in Vancouver, B. C. During the approaching session of the Dominion Parliament an effort will be made to have a bill introduced defining the term "civil engineer." Another important item taken up in the report is to the effect that consideration has been given during the past year to publicity matters affecting the profession of civil engineering. A circular is about to be issued with a view to instructing municipalities as to the advisability of employing only corporate members of the society, and it is also proposed to request corporate members, when advertising for assistants, to require that their candidates must be members of the society. A special committee appointed by council has under consideration at the present moment the best means of securing the appointment of engineers to civic boards, and commends the matter to the membership in general as one deserving of their support.

To Define "Civil Engineer"

Mr. G. A. Mountain, referring to the statement in the report that an effort will be made during the approaching session of the Dominion Parliament to obtain an act defining the term "civil engineer," suggested that a change in the name of the society might be desirable. As they were closely allied with the British Institution he thought the name Canadian Institute of Civil Engineers would be a better one than the present title. It would sound as if they were more of an educational institution, and they might thus be able to secure advantages from the Government in the way of reduced or free postage.

The President suggested that the matter be taken up at a later period.

Mr. W. McNab drew attention to the representations made by the Council to the Department of Railways and Canals, Ottawa, to the effect that the Society's specification for steel bridges should be adopted by the Dominion Government—a subject which is still under the consideration of the chief engineer of the department. Mr. McNab hoped that the representations would be more successful than others addressed to the Department.

Mr. W. J. Francis remarked that Governments were proverbially slow in making changes, and the Department wanted to carefully consider the matter before they made any change.

The President said his experience was that Governments considered a long time before they threw over their own specifications in order to accept those of the society.

Professor McLeod stated that the Department had written to the effect that the completion of the specifications on highway bridges would facilitate the consideration of the whole matter of the specifications.

The report was then adopted.

The remainder of the morning session was occupied by a discussion on the treasurer's statement and the report of the finance committee. The year's revenue totalled $22,079, and the expenditure $19,774, leaving a balance of $2,304.

Finance Report

Mr. R. A. Ross moved the adoption of this statement and the report of the Finance Committee. The latter called attention to the serious position in which the society is placed in consequence of the existing state of war, with consequent absence of members (30) at the front and the falling off of new membership because of conditions existing in engineering generally throughout the country; the result being a serious reduction in receipts for the next and probably the following years. During 1915 arrears of dues to the amount of $6,733 were collected, and it was calculated that $2,000 would be collected in 1916. It is expected there will be a shrinkage in revenue during the current year of about $7,000, and the committee outlined a number of economies which can be effected, with the result that in their view the revenue of 1916 will show an operating deficit of about $1,633.

It was stated in the course of a discussion which followed that the arrears for 1915 were $10,932, and that the total arrears, including the above, are between $17,000 and $18,000. It was also stated that a committee had decided to undertake a vigorous campaign in order to get additional members. The work of the Finance Committee was recognized as being satisfactory and the statement and report were adopted.

Discuss By-laws of Society

For nearly three hours, in the afternoon, the members discussed the question of the bylaws, the general status of the society, and the need for changes which would make for greater success, particularly in relation to the various branches. This is an old subject, which was brought to the fore by the British Columbia members, who desired an amendment of the bylaws.

Mr. E. W. Oliver moved the appointment of a committee to examine the bylaws and make recommendations for their amendment. He argued that the bylaws required amendment, and said that it could not be doubted that there was dissatisfaction with the affairs of the society. It was frequently said that the affairs of the society were managed for the personal edification and convenience of a group in Montreal. He had entirely changed his view on that subject since he had obtained fuller knowledge of the working of the society, and many of the Montreal members who had taken a leading part in the society should be thanked rather than criticized. He was in favor of radical changes in the bylaws, and he suggested that the whole proposition should be fully discussed by all branches in the Dominion.

Professor Haultain seconded the resolution.

Mr. J. A. Jamieson moved an amendment covering much the same ground as the motion. It favored the appointment of five to report upon the general policy, prestige and influence of the society, the means of raising the membership, the appointment of a permanent secretary, etc. The five members from the headquarters should be added to by representatives of the branches. He believed that the majority of the members were of opinion that they had only a small part in the affairs of the society, due to the system in operation. He thought that there was a certain lack of harmony between the members, and the appointment of such a committee as he suggested could only result in benefit to the society. On the question of a permanent secretary devoting all his energies to the society, the time would come when such an arrangement would have to be made.

Mr. Edwards (Edmonton) argued that the district should be the unit of organization in any new arrangement. Each district should elect its own members to the Council. It was difficult under present conditions to convince engineers that they should join the society.

Mr. H. R. Safford believed that the time had come to review their constitutional structure, and they ought to provide means for an extended discussion on the subject. Other and older institutions had experienced similar troubles, and he strongly endorsed action in best interests of the society.

Mr. C. H. Keefer was in sympathy with Mr. Jamieson's suggestions, believing that they would stimulate interest in the society in the outlying districts.

Mr. Conway supported the idea of reconstructing the basis of the society. They must co-ordinate the work of the society throughout the country. Good work was being done by the society throughout Canada, but it was not sufficiently known. There were many engineers outside the ranks who should be members of the society. He favored bringing into greater prominence the provincial bodies and branches. What was the use of electing provincial men to the council when the work had to be done by a few members in Montreal? He suggested the issue of a monthly magazine giving a record of what was being done by the society, and the appointment of an editorial committee to improve the publication of the Transactions. He favored appointment of a permanent secretary, and in this connection spoke of the excellent work done by Professor McLeod for many years.

Mr. R. F. Uniacke spoke in favor of some amendment to the constitution.

Professor Haultain said that the great trouble was the scattered membership, and a want of understanding.

Mr. R. A. Ross believed that the criticism was a healthy sign. What was required was a Council containing some young blood with new ideas. At the same time the present Council should not be sidestepped in any action which was taken.

Mr. F. W. Cowie said that undoubtedly amendments were needed in order to bring the constitution more in accord with present requirements.

Object of Society

Sir John Kennedy pointed out that the main object of the society was to improve their professional knowledge. They also wanted to unify the society as much as possible, and the tendency was to unify subjects rather than territory. It was a great thing to have a national society and they must endeavor to preserve this, and not to split it up into sections. He also remarked that in B. C. the main engineering work had been done by men who came into that province from outside. He urged members to get together in a practical way to improve the society.

After further discussion it was agreed that Mr. Conway, Mr. Jamieson, and Mr. Oliver should consult with a view to drafting a resolution agreeable to all three.

The reports of the various branches having been received, Prof. Brown moved and Mr. Francis seconded, the adoption of the report on Portland Cement. This was agreed to.

Report on Portland Cement

Specifications for Portland cement recommended by the committee for adoption by the society are given herewith. The requirements of this specification are uniform with those of the standard specification of the American Society of Civil Engineers and the American Society for Testing Materials. The standard methods of testing as approved by the American Society of Civil Engineers are also recommended for adoption, and the committee suggest that the council ask permission of the American Society to reprint their document embodying these standard methods.

Standard Specification for Portland Cement General Clauses

Definition.—Portland cement is the product resulting from the fine grinding of the clinker formed by the calcination of an intimate mixture of calcareous and argillaceous materials, in proper proportions, to which may have been added subsequent to calcination not more than three per cent. of other material.

Weight.—Unless otherwise agreed upon, cement shall be delivered in bags, each containing 94 lbs. net weight. Four bags shall constitute a barrel.

Packages.—All bags in which cement is delivered shall be made of good strong fibrous material, closely woven and in good repair when filled. The following information shall be plainly marked on each bag:—

(a) the net weight of cement contained therein,

(b) the name of the manufacturer,

(c) the brand of the cement, or the name of the mill in which it was manufactured.

Inspection.—All cement shall be subject to inspection and tests for quality, either at the place of manufacture or at the point of consumption. Every facility shall be provided and a period of at least 12 days allowed, for inspection and tests.

Storage.—Unless otherwise agreed upon, the contractor shall provide a suitable weather-tight building for the storage of cement, and easy access shall be provided for the sampling and identification of each shipment. The floor of the building shall be well raised above the ground and the space below it shall be well ventilated.

Testing

Methods.—All tests shall be made in accordance with the methods recommended by the Special Committee on Uniform Tests of Cement, of the American Society of Civil Engineers, accompanying the Final Report of that Committee dated January 17th, 1912.

Requirements

Acceptance or Rejection.—The acceptance or rejection of cement shall be based upon the following requirements, but cement failing to meet the seven-day requirements may be held awaiting the results of the twenty-eight-day tests before rejection.

Specific Gravity.—The specific gravity of cement shall not be less than 3.10. Should the cement as received fall below this requirement, a second test may be made upon a sample after ignition at a low red heat. The loss of weight on ignition shall not exceed 4 per cent.

Fineness.—The cement shall not leave a residue of more than 8 per cent. by weight on a No. 100 sieve, nor more than 25 per cent. by weight on a No. 200 sieve.

Time of Set.—The cement shall not develop initial set in less than thirty minutes, nor final set in less than one hour. Final set shall develop within ten hours.

Tensile Strength.—The minimum tensile strength of briquettes one square inch in cross section shall be as follows, and there shall be no retrogression in tensile strength within the periods specified.

Neat Cement

Age.	Tensile Strength.
24 hours in moist air	175 lbs.
7 days (1 day in moist air) (6 days in water)	500 lbs.
28 days (1 day in moist air) (27 days in water)	600 lbs.

One part cement, three parts Standard Sand

Age.	Tensile Strength.
7 days (1 day in moist air) (6 days in water)	200 lbs.
28 days (1 day in moist air) (27 days in water)	275 lbs.

Constancy of Volume or Soundness.—Pats of neat cement about three inches diameter, one-half inch thick at the centre, and tapering to a thin edge, shall be made and kept in moist air at 70 degrees F. for 24 hours, following which,

(a) One or more pats shall be kept in air at 70 degrees F. and observed at intervals for at least 28 days.

(b) One or more pats shall be kept in water at 70 degrees F. and observed at intervals for at least 28 days.

(c) One or more pats shall be exposed for five hours to an atmosphere of steam, above boiling water, in a loosely closed vessel.

The pats shall in all cases remain firm and hard, and shall show no sign of distortion, checking, cracking or disintegration.

Sulphuric Acid and Magnesia.—The cement shall not contain more than 1.75 per cent. of anhydrous sulphuric acid (SO_3), nor more than 4 per cent. of Magnesia (MgO).

A letter was read from Mr. W. G. Chace, chief engineer of the Greater Winnipeg Water District, raising certain points as to the report, and Prof. Brown replied to these in detail, stating that they had been considered by the committee. The report now becomes the standard specifications of the society.

In the evening a smoking concert was held in the society's rooms.

Visited Vickers Works

On Wednesday morning a large party visited the works of Vickers, Limited, Maisonneuve, the meeting resuming its session in the afternoon, when Mr. Oliver brought up a resolution as to by-laws, etc., agreed upon. It was to the effect that the Council be instructed to appoint a committee to study and report upon a policy for increasing the prestige, influence and organization of the society and to revise its by-laws. The committee is to consist of representatives of each district. This was carried.

A letter was read from Mr. J. G. Legrand, of Winnipeg, referring to the part of engineers in the war, and expressing the opinion that engineers should make suggestions to the Government, with a view to improving our efficiency in fighting our foes. He also urged that in view of the common danger petty politics should be repressed.

Arising out of this letter, Mr. Conway raised the question of assistance by the Society in training engineers who desired to become officers of engineering corps. Mr. Francis replied that the council had had this matter under consideration, and had co-operated with the engineers' corps which had gone to the front and also with the Institution of Civil Engineers. Mr. Francis took the opportunity of deprecating the pessimism which had tinged some of the speeches. On the contrary he said there was no decreasing interest in the society. Mr. Ross added that the Council had offered the services of the Society to the Government in any direction thought desirable, but had been turned down.

The conservation, electro-technical, roads and pavements, steel bridge specifications, and educational requirements were laid before the meeting.

Report on Steel Bridge Specifications

The chairman, Mr. P. B. Motley, stated that the specification for steel railway fixed spans had already been issued, but owing to the great diversity in practice, as well as in the details connected with the subject of highway bridges, the committee had found it impossible to complete this specification in time for the annual meeting. The draft, however, will be ready for preliminary discussion by the branches at an early date, and should be ready for submission at the next annual meeting.

Report of Electro-Technical Committee

Dr. L. A. Herdt, chairman, reported that owing to war conditions the international congress planned for September of last year could not be held at San Francisco. A conference had been held in London in March on the rating of electrical machinery, and copies of the British standardization rules for electrical machinery as adopted at that conference will shortly be available for distribution in Canada.

Report of Committee on Roads and Pavements

The chairman of this committee, Mr. W. A. McLean, stated that in the opinion of a majority of his committee it is not desirable at the present time to prepare standard specifications for roads and pavements, though consideration might be given to specifications for certain materials. They desired to impress, however, that there is a great waste of experience in the matter of road construction and paving at the present time due to lack of any organization to assemble the results of such experience. As a result it semed desirable that the committee should assume the duty—first, of determining uniform traffic standards whereby wear can be more definitely compared, and, second, of the compilation of the history of individual pavements. To this end the co-operation of engineers throughout Canada would be necessary so that each should supply from year to year definite details of such pavements as came within his particular knowledge. Appendix 1 and Appendix 2 were attached to the report as suggested forms which would be suitable for the collection and filing for reference of the desired information.

Interesting reports were also presented by Mr. James White, chairman of the committee on Conservation, Mr. Ernest Marceau, chairman of the committee on Educational Requirements, and Mr. J. M. R. Fairbairn, chairman of the Library and House committee.

The President then delivered his retiring address, which in part said:

Mr. Gamble's Address

The past year has been one of stress and anxiety. The British Empire has been engaged for eighteen months in the greatest struggle in the history of the world with a nation which for over forty years has been unsparing in preparation for imposing upon the world by force its system of civilization and "Kultur." Notwithstanding the serious handicap of unpreparedness under which the Empire entered upon this war, the British Army under the unsurpassed guardianship of the Grand Fleet, and supported by contingents from the Overseas Dominions, has withstood the violent attacks of the enemy in Flanders and France with courage and valour. It is not too optimistic to say that the ultimate end shall be the triumph of British principles of liberty and justice. To assist loyally in the task thus imposed upon the Empire three hundred and sixty-three members of our Society (ten per cent. of the total membership) have given their services freely, of which number thirteen have so far made the supreme sacrifice. We honor those who have died that the Empire may live, and extend to their relatives an expression of our admiration and deepest sympathy. While the memory of their deeds will remain in our hearts as long as we live, it is but fit and proper to commemorate by a tangible token their noble patriotism and unselfish surrender of their lives.

In one way the Society has already marked its appreciation of this by remitting the annual dues of members actively engaged at the front. This should meet with the unanimous approval of members.

We have to mourn the loss by death during the past year of sixteen members, including juniors and students. Of these thirteen were killed in action, to which a previous reference has been made. Of the others special mention should be made of the late Mr. T. C. Keefer, C. M. G., first and tenth president of the Society and afterwards Honorary Member, and of Sir Sandford Fleming, who became a member in 1896, and was made an Honorary Member in 1908. These gentlemen conferred a marked distinction upon the Society, having acquired by probity, eminent ability and usefulness, world-wide reputations. Their careers must be an inspiration to the younger generation.

There are many Civil Engineers living in the Dominion of marked ability who still hold aloof from us. These can only be induced to join by raising the Society to its proper plane of usefulness, and increasing its sphere of influence. Solicitation to join us must be avoided as an undignified and weak expedient. It is quality not quantity that is desirable. A most essential factor in bringing about the increase in our membership, attracting to us the most accomplished Civil Engineers, is the firm and courageous carrying out of "The Code of Ethics" adopted by the Society.

The profession of Civil Engineering, owing to its somewhat uncertain position, having no legal standing, differs from other professions which enjoy the law's protection, and, therefore, there is the greatest necessity for members to practise the virtue of loyalty to each other and to the profession. If each member realizes his responsibility in this respect public esteem and confidence will increase.

The Council during the past year has been active in bringing to the attention of governing bodies, Federal, Provincial and Municipal, matters of importance and intense interest to the profession of Civil Engineers practising within the bounds of the Empire. Although no direct beneficial results have been achieved so far, we have no reason to be discouraged. In the coming year, if the past representations are firmly and fearlessly persisted in, some measure of success will without doubt attend our efforts. We are not demanding anything unreasonable or beyond our rights as citizens. We should resent firmly any adverse inference to be drawn from the continued indifferent treatment meted out to the profession by public bodies in Canada. The amelioration of the disabilities under which we labor at present is one of our just demands.

The Society through the Council might well direct its energies towards securing the adoption by governments, for Civil Engineers in the public service, of a standard of qualifications. The Institution of Civil Engineers took this question up with the Imperial Government, meeting with a sympathetic response, and this Society should not hesitate to move in the same direction.

(For List of 1916 Officers see page [illegible])

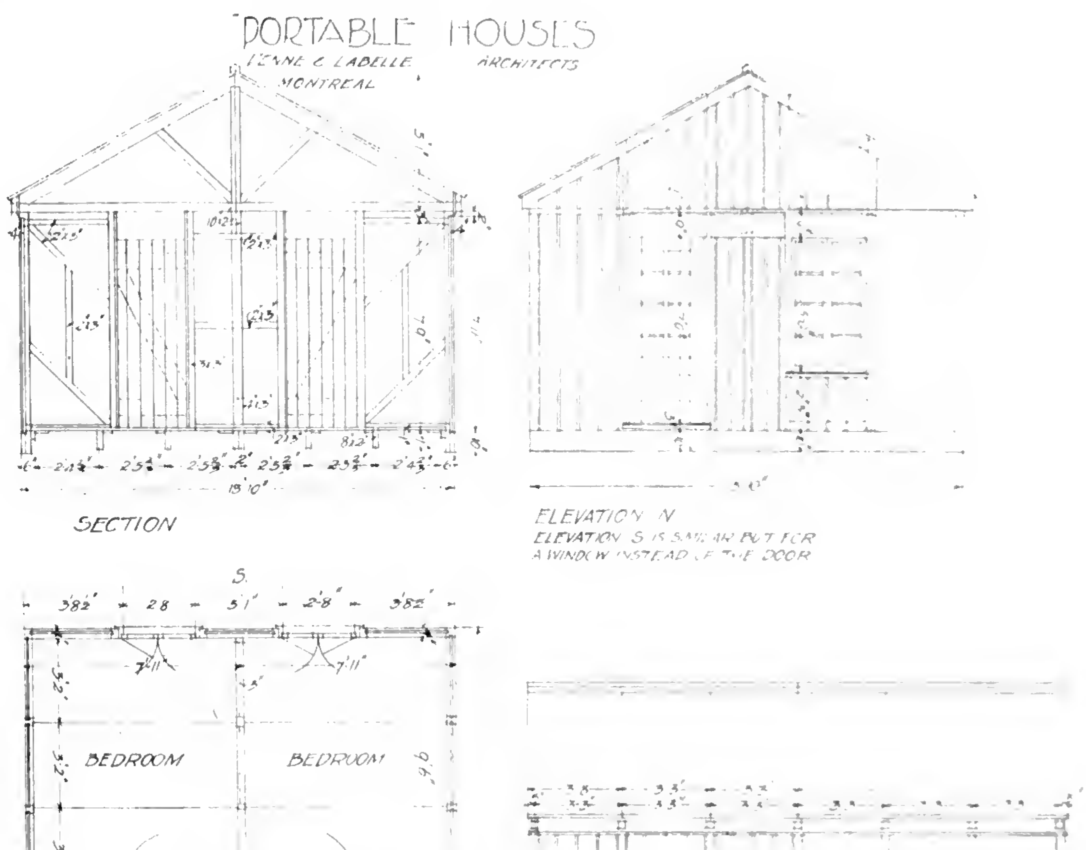
Portable House for Proposed Gift

The following is a brief description of the plans of a wooden portable house, fifty of which the Canadian Timber Products Association propose donating to the devastated portions of France and Belgium.

The figures herewith show the plan, elevations, and an isometric perspective of the design chosen. The houses are built of lumber, using a roofing material such as tar paper, asphalted paper, rubberoid, or ready roofing, with an interior trim, if desired, of beaver board.

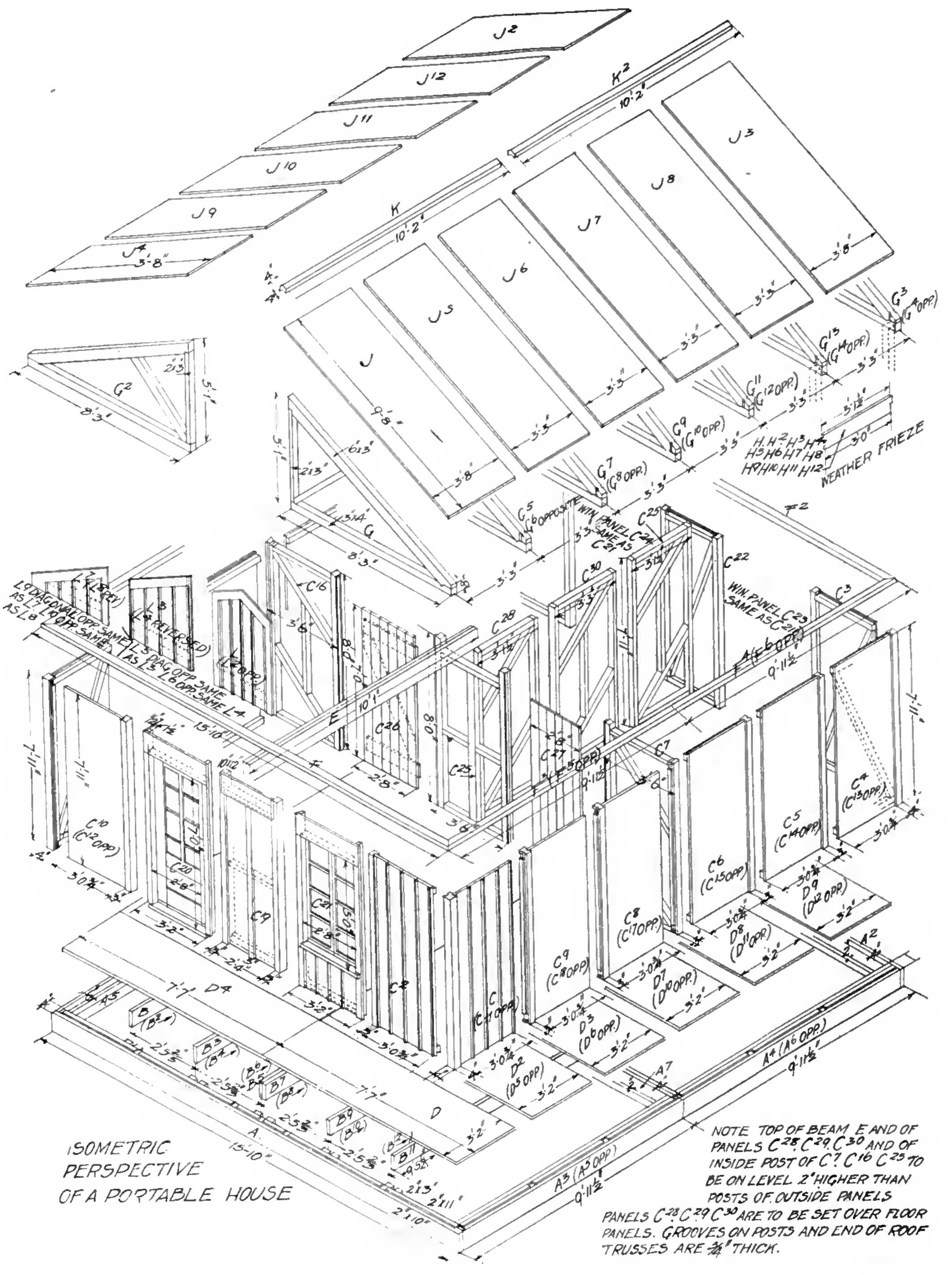
The structure is 15 ft. 10 ins. by 19 ft. 11 ins. plan dimensions, approximately 14 ft. high, contains three rooms, with a uniform height of storey of 8 ft., and has three windows and a door. The front room, or hall, is 9 ft. 6 ins. by 15 ft. 5 ins., while the other two rooms, which may be used as bedrooms, are both 7 ft. 7 ins. by 9 ft. 6 ins. inside dimensions.

The building is as simple and symmetrical in design as possible. The front elevation contains a door and a window, and the rear elevation is similar but for a window in place of the door. Both side elevations are of similar design, each being built of six 3 ft. 3 in.



Suggested plans of Portable House for Proposed Gift from Ontario Lumbermen to France panels grooved ready to fit one another and to receive the top and bottom rails. The floor is made of 1-in. tongued and grooved boards, dressed on the wearing surface, laid in six sections each 3 ft. 2 ins. wide, nailed to five 2 x 8 in. joists. These joists rest on 2 x 3 in. blocks nailed to a base girt composed of a 2 x 10 in. plank 15 ft. 10 ins. long, spiked to a 2 x 11 in. plank which is notched to receive the uprights. The roof is built in two halves; each half is made of a 3 x 4 in. tie beam framed and notched to the main rafter and to the 2 x 3 in. half king post. The rafters are made of 3 x 6 in. material framed to the tie beam and half king post. The roof, similar to the sides, is put on in panels the same width as the side panels, made of 1-in. tongued boards nailed to cross-pieces. The door is 7 ft. 1 in. by 2 ft. 9 ins., built of 1½ in. material with one flush panel, and prepared to receive eight panes of glass. The three windows are 5 ft. by 2 ft., made of 1½ in. material with two sashes prepared to receive four panes of glass.

A detailed bill of quantities of the material necessary for this portable house has been drawn up. It is proposed to have the makers mark each piece with a distinct sign or letter, tie all similar pieces together, for the sake of order and method in shipping, and to secure thorough, easy, and rapid assembling by inexperienced hands. It is roughly estimated that these houses may be produced at an actual cost of $150.00.



Isometric perspective of Portable House planned for presentation to France.

Large Concrete Cantilever Trusses

Support Sewer over half mile of river flats at Victoria, Australia

EVIDENCE of the possibilities of reinforced concrete construction is strikingly shown in the new cantilever truss design for carrying a reinforced concrete sewer over a crossing of nearly a half-mile in length of river flats in Australia. A brief description appears in a current issue of Engineering Record, and the accompanying illustrations give a fair idea of the unusual character of the structure.

The structure is located in Victoria, Australia, and was adopted after alternative designs in both steel and reinforced concrete had been made to carry the sewer, which is part of the recently installed sewer system of Geelong across the River Barwon and the river flats.

Near view of foundation showing spread of cantilever.

The total length of the structure is 2,424 feet, consisting of thirteen spans of 176 feet and one span of 136 feet. The suspended spans are 40-ft. girders, free to move at one end. The cantilever design is economical and has a further advantage in the fact that all temperature variations can be provided for by horizontal movement at expansion joints. This consideration ruled out the possible alternative of a series of arches, in which temperature movements are vertical and would create a series of undulations very undesirable, because the grade of the sewer is only 1 in 2,500.

The distance between cantilever trusses is increased toward the piers in order adequately and economically to resist the horizontal wind forces. The lateral bracing consists of transverse struts with knee braces to the main chords, as seen in the photographs.

The reinforced-concrete pipes are oval in form and cast in 8-ft. sections, which correspond to the 8-ft. panel lengths of the trusses. Cross beams and struts thus support the pipes at their joints. The same forms were used for the pipes on the structure as for the main sections of the sewer.

The reinforcement throughout is of ordinary steel rods, the full tensile strength being developed at the splices by laps; in no case are they mechanically connected. The rods in the upper chord are arranged in concentric rings, the laps of which break joints along its length. The diagonals are in tension, and the ends of the rods through them are accurately pent around the rods in the upper and lower chords.

A footpath is provided throughout the whole length, and the details of its treatment add very considerably to the appearance of the work. The handrailing of the footpath is sufficiently reinforced to act as a girder. It was thus possible to maintain a continuous footpath form.

The John V. Gray Construction Co., Ltd.

It has just been announced by Mr. John V. Gray that he has severed his connection with the firm of Wells & Gray, Limited, Engineers and Contractors, Toronto, and has organized a company named the John V. Gray Construction Company Limited, with head office at 346 Confederation Life Building, Toronto. This firm is now prepared to give estimates and tenders on and carry out contracts for the erection of all kinds of buildings, specializing on modern reinforced concrete, brick and mill construction buildings for all purposes as well as cold storage and packing house buildings. In the circular letter just issued by Mr. Gray he points out that he has had nearly thirty years practical experience in all kinds of construction work, and that his future policy, as in the past, shall always be to exercise strict honesty in all his dealings, to do the best gradé of work and to give those with whom he deals as nearly as possible perfect satisfaction. Those who know him best will appreciate most his sincerity and ability in this matter.

Cantilever Trusses and Cross Beams support oval pipe Reinforced-concrete construction throughout.

Montreal Builders' Exchange Annual

The annual general meeting of the Montreal Builders' Exchange was held in the reading room of the Exchange, 52 Victoria Sq., on Monday, January 24th, the president, Mr. John Quinlan, in the chair.

In his presidential report Mr. Quinlan stated that while the Exchange during the past year had not undertaken any work of a specially aggressive character and had continued its policy on familiar lines, yet its membership had been consolidated and its finances strengthened. The membership now embraced all classes of firms engaged in the building trades and

Mr. John Quinlan, re-elected President of the Montreal Builders' Exchange.

had become more and more recognized as the official organ of the building interests of the city. The year 1915 would be long remembered as an extremely trying one for the building trades, especially in the city and island of Montreal. That the members as individual business organizations had been able to keep moving upward, if only in a small degree, was due to their natural ability to change their methods to suit altered conditions, to develop their business along various new lines afforded by war conditions, to supply material at prices which afforded a fair legitimate profit only, to deal with labor in a generous spirit, having due regard to all factors which entered into the wages problem, and finally to bringing into their several organizations the latest modern methods, the use of up-to-date labor and time-saving machinery, and by maintaining an honorable reputation for skill, honesty, and responsibility.

In the immediate future, the building operations in Montreal would proceed along lines different from those that had obtained in the past. The city at present had sufficient office accommodation for years to come; he thought, however, they would see a considerable extension of structures suitable for manufacturing and industrial plants. Of the higher priced residential buildings there were more than sufficient for immediate needs, but there was a steady demand for homes of a moderate price and especially of the cottage or semi-detached villa type, and if the increase in population took place which was so confidently predicted in several authoritative quarters, they might expect to share abundantly in the work of erecting homes for the people. Mr. Quinlan suggested that there was room for a central library, museum, a public hall suitable for great political meetings, etc., a civic art gallery, a winter garden and concert room, and many and convenient comfort stations.

On the subject of the civic fair wage schedule, the delegates of the Exchange were able to convince a civic committee of the unfairness of the wages proposed, but the schedule was finally adopted. For the current year it had been decided that the Builders' Exchange and kindred organizations and the various labor unions be consulted before the schedule was drafted, and this would make for more equitable terms and more harmonious working.

After referring to the means taken to promote Federal free labor bureaus throughout the country, Mr. Quinlan spoke of the Industrial Disputes Act and also efforts made, with others, to bring about a reform in the Government of Montreal.

A committee had been appointed to study the proposed bylaws regulating the erection of scaffolds in the city.

During the year the relations between the Exchange as employers and the workmen had been most harmonious. He noted the greater ease with which organized labor and the various trade sections of the Exchange approached one another and sought to arrange their differences without the intervention of outside parties.

In the near future the Exchange should busy itself in formulating some scheme to take the place of the old trade apprenticeship system, which many observed with regret was passing away, if it had not wholly done so, in the city. In the years to come the workshops would be wholly dependent for their supply of skilled labor on outside sources and capable youths of the country would find their energies restricted to a narrower field. It was possible, he suggested, to draft a plan on lines similar to those adopted in some older countries of the world, modified of course to suit local conditions, whereby sturdy boys could obtain their practical training in shops or on construction works and their theoretical training and knowledge of the principles underlying the operation of their trades in schools specially organized and equipped for this purpose. The provincial Government had established throughout the province technical schools, which were doing excellent work, but if the greatest good was to be obtained there must be developed a plan whereby the school and the workshop could be brought into still closer contact.

A committee had been appointed to examine the whole subject of greater co-operation between the members of the exchange and the members of affiliated bodies.

Mr. Quinlan concluded by expressing his appreciation of the cordial assistance given him by the directors, and of the harmonious relations which had prevailed.

Mr. D. K. Trotter, the secretary, submitted the financial statement and report showing receipts of $5,318.30 and expenditure of $5,030.03, leaving a balance of $288.27. He made a number of suggestions for strengthening the exchange by the addition of new members and by securing various trades sections organized and affiliated with the Exchange.

A long discussion on the civic paving law followed. This was participated in by the President and Messrs. J. H. Hand, J. J. Roberts, E. W. Sayer, F. B. Locker, J. P. Anglin, and John Allan. The question at issue is as to whether the city or proprietors should pay for paving improvements and in view of the sharp divergence of opinion it was decided to appoint a date for a special meeting to discuss the subject, before which date all the members of the exchange should be invited by special circular to express their views, and in the meantime to have all the information on the subject of the paving laws ready to hand.

The election of officers resulted as follows:—President, Mr. John Quinlan (re-elected); 1st vice-president, Mr. E. W. Sayer; 2nd vice-president, Mr. J. P. Anglin; directors, Messrs. Walter Bonnell, representing general contractors; Alex. W. Bremner, suppliers of building materials; Alex Charette, master plumbers; Robt. F. Dykes, cut stone contractors; J. W. Graham, mantle and tile dealers; John H. Hand, Wm. Irving, and W. C. Munn, general contractors; W. E. Potter, master painters; W. E. Ramsay, suppliers of roofing materials; J. J. Roberts, carpenters and millmen; and J. E. Walsh, master plumbers. The trade representatives in the above are Mr. Alex. Charette, representative director appointed by Master Plumbers' Association, and Mr. J. W. Graham, representative director appointed by Mantle & Tile Dealers' Association.

England's Malady—The Party System

By Cosmo Hamilton

One night, with the memory of the South-African War still stamped upon his leonine face, a little old man whose small eyes were charged with a kind of prophetism went into his study, threw down the notes of a speech that he had just delivered in the House of Lords, sank rather feebly into a chair, and burst into tears.

There were two younger men in the quiet room, tall, wiry men on whose faces and figures discipline had laid its restraining hand—soldiers both. Their sympathy was inarticulate. And then the old man spoke.

"Curse those fools!" he cried. "Curse them! They won't listen to me. I am a mere damn' soldier. I am talking facts, and they know it; but the system, that unique and criminal system of party politics, renders them absolutely impotent even if they desired to take advantage of the evidence that I have flung at their heads. I told them that the British army has only just escaped being whipped by a pack of farmers, that the flower of English manhood, unready because of these little clever people who sit at Westminster, has manured the wide stretches of the veldt, where their gravestones are meaningless. Will they take a lesson from this two-years' national disgrace? Will they organize the whole Empire by a form of compulsory service to meet the menace of the great Teuton machine which every day is being perfected for its inevitable use? No; I tell you, no. And yet, by God! there are a few men sitting in the House of Commons not yet so warped and twisted by the dishonesty of the party system that deep down in what remains of their souls they know that my stammering words are true. 'Compulsory service? Yes, that is the solution,' they say; 'but what kind of fools shall we be considered by our friends if we sacrifice our political careers for the sake of patriotism?' No, it's no use. Stop me ever from getting on my feet again. I am hurling my old body up against the brick wall of a political system that one of these days will place England under the feet of a determined, self-sacrificing, industrious and brutal enemy."

That little old man was Field-Marshal Earl Roberts of Kandahar.

* * *

Dinner was over; the servants had left. The thin smoke of cigars and cigarettes rose up to the gilt ceiling of the large, dignified room when the laughter and conversation of the men whose faces and figures formed the subject of caricatures in the English papers suddenly died away. The host, a bearded man with a high forehead and heavy bovine eyes, leaned forward. In his rather fine white hand he held a thick amber cigar-holder, which he used as a sort of baton to enforce his words.

"Gentlemen," he said in the peculiar guttural voice which was known and loved in many strange parts, "look out! I have asked you here on my return from Germany to say to you, look out! A colossus is stretching himself. Every great muscle of his arms is taut and hard. Every little cell of his great brain reverberates with two words only, 'Der Tag.' . . . . We live in a false security here. We are a democracy which tolerates a monarch. You, gentlemen, are our autocrats. Each one of you is the king of England. What are your majesties going to do? Are you going to continue to play Canute and hold up your hands to the waves and say, 'Back!'? Are you going to continue to sit within the apparently impregnable walls of your party system? Because, if so, the security of this kingdom and your little crowns is not marketable. There are no bidders. I say to you again, look out!"

That man was King Edward VII. of Great Britain and Ireland.

* * *

There was only one policeman outside that little, dull, unpretentious house in Downing Street in which much regrettable history has been made, and from which one generation after another has been misgoverned and misled by premiers and their satellites. On his chest were the ribbons of medals won in India and South Africa, and in his eyes there was the look of a man who fears that he is about to face unutterable disgrace.

He has watched one member after another of the British cabinet scamper up with white lips. From where he stands he can see the complicated system of wireless telegraphy on the roof of the Admiralty. He knows well, like every other man of the nation to which he belongs, that a message has been framed to be despatched from those wires to the great ships that lie waiting off the coast. He knows also that the hands of the army and navy are held by the grip of the party system, and that the agreements of his country with her allies may be broken, to her everlasting shame, by those frightened, panic-stricken men who have rushed up from their country houses to attend the cabinet meeting within.

There sat Mr. Asquith, the prime minister, with ashen face and hands shaking like a man with palsy. All round the table were seated the men who had trifled with their trust. Their teeth were chattering. They were face to face

*In Century Magazine.

at last with the truth which they had dodged and refused to recognize.

"Why should we fight?" they stammered. "We are a peace-loving nation, unready for bloodshed. Let the others fly at one another's throats, and while they kill and devastate we will grow rich. Are we not a nation of shopkeepers?"

"Listen!" said Mr. Asquith.

From all parts of Great Britain and Ireland—yes, Ireland—there rose an ever-increasing rumble of passionate protest, like the breaking of huge waves upon rocks. Bugles seemed to ring out, and from every town and hamlet there appeared to rise up millions of hands. Near by a bell was tolling.

Mr. Asquith looked up and all round, catching the troubled eyes of his henchmen.

"Oh, my God!" he said, "our servants have become our masters. They demand that we shall fight. Gentlemen, the party system is dead."

* * *

The party system! The House of Commons is divided into two bodies. On one side of it sits the party in the majority, on the other side the party in the minority, and over them both the Irish. The House of Commons purports to represent a great country whose history gleams with the heroic results of individual effort. The constitution of all the men under the roof of that House is the same. Whether they call themselves Conservatives or Liberals, they are not there for reasons of patriotism. They have entered politics for the same reason that takes men to the stock-exchange and upon the stage—for money and for advertisement. On both sides there are men who own newspapers, run simply for the purpose of grinding their little axes, in which they may hurl sham invective at their fellow-conspirators and write columns of self-praise. On both sides there are lawyers who have tacked on politics to their profession so that they may stand in the lime-light, pick up the plums, and manipulate commerce to their own benefit. On both sides there are bankers and publicans, journalists and company-promoters, city merchants and the poverty-stricken relatives of the great political leaders, who will obey orders, answer the party whip, and sell their souls for a mess of pottage. On both sides there are little creatures from the back alleys who have been educated to politics as a means of livelihood, and who are perfectly willing to assert that black is white or vice versa whenever they can gain by doing so. The majority are, ipso facto, the enemy of the minority, and the Irish hate them both; but the minority, majority, and Irish are all working together for their own ends. They may call themselves Conservatives, Unionists, Radicals, Liberals, Nationalists, Fenians, Anti-Vivisectionists, Little Englanders, or any one of the dozen meaningless names which have grown into the English language, but they remain mercenaries and parasites, the manipulators of a party system which is a cunningly built-up conspiracy to mislead the country, misrepresent its voters, and provide places for the incapable sons of peers and yearly incomes for specially chosen men whose integrity has been proved to be easily bought, and whose eloquence, like that of a criminal lawyer, is as ready to be used in defense as in prosecution.

In a word, the party system of British politics is the one corrupt thing in the constitution of that nation. The House of Commons has become the happy hunting-ground of a dozen great families whose members pass into it from time to time by the same right that men pass into the business firms of their fathers. They are all partners in a great swindle, and their clerks and henchmen, hired from the law, the universities, the factories, and the streets, vary only as their masters see fit. Those masters, nearly equally divided on both sides of the House, agree from time to time to take the reins of office, paying themselves large salaries, large pensions, giving places only to those men who have been most obsequious and most eagerly dishonest. They juggle with the votes of the country, with their tongues in their cheeks. They are past-masters in card-sharping and the three-card trick. There is not one man among them with the faintest gleam of imagination, patriotism, or understanding of the characteristics and spirit of the race whom they bluff by inheritance. Yes, there is one—the Mark Antony of the House of Commons, the little Celtic man whose name is Lloyd-George, who possesses the three gifts that go to the making of a great charlatan—a pair of wonderful eyes, a sense of impish humor, and that touch of exaltation which stirs men to hysteria. He is the Pied Piper of politics, the man whose little flute can draw from their dark places the laboring parties of the United Kingdom. He is the great democrat who has organized a bureaucracy more autocratic than anything in Russia. He is the king of charlatans.

England is a free country, a democracy which tolerates a monarch, and is governed by a royal family of hereditary politicians supported by a nation of slaves.

Let a young man enter Parliament big with a desire to get things done, imbued with honesty of purpose, honest enthusiasms, honest patriotism, and a great wish to devote his energies, abilities, and all his time to the amelioration of one or other of the evils which have been left coldly alone by the party system, and he goes into a mausoleum of broken lives over the portals of which is written the terrible legend, "Give up hope, all ye who enter here." The result of his temerity is inevitable. He has either immediately to sacrifice honesty to selfishness or to rush back into the world once more to breathe uncontaminated air and to hurl invective, unnoticed, uncared-for, at the men who year after year deliberately stand in the way of progress and with the utmost cunning lay stone after stone upon the great dam which holds back the waters of improvement and incloses in wonderful security the confidence-men who live upon the credulity of the British public.

The party system of Great Britain is responsible for the degeneracy of a great nation. It is responsible for the unemployment of its working-classes, for the tyranny of its trades-unions, for the sense of injustice which, but for Germany, would have seen insurrection in Ireland. Finally, it is responsible for the unforgivable devastation of Belgium and for all the bloodshed, for all the hideous waste of life, money, material, and for the chaos of civilization under which, in pitiful attitudes, the fathers of the next generation lie crumpled and dead.

Every widow, every orphan, every maimed man in Europe to-day; all those poor boys from Canada, Australia, and New Zealand; every Frenchman, Belgian, Indian, Russian, Italian, African; every man who has sprung to arms, left his civil work, his little patch, his quiet haven where the patter of children's feet has been the music of his life, has to thank the English party system for this war. Countries as crippled as their sons, who have crept back like whipped dogs to a kind of life, will for ten, twenty, maybe a hundred, years hence have to thank the English party system for this hideous, unnecessary, preventable war. If there is yet one spark of remorse in the little souls of the men who have sat so long at Westminster greedily taking their salaries for the non-performance of their duties, then the quiet lunatic asylums which stand among the silent poplars of English country-sides must soon be full. If not, if their long service to dishonesty has eaten into them, if they see no shame in having permitted their country to slip into unreadiness and inefficiency, these little, petty harpies, these hypocritical self-advertisers, may have the satisfaction of wallowing in a sort of triumphant pool of exaltation; may congratulate themselves on having achieved an act of incendiarism so frightful that the bloody glow of its flames lights up every corner of Europe.

Mr. Balfour, the theorist, the gentle, gentlemanlike university professor, upon whose gravestone will be carved the words, "Nothing have I ever achieved"; Mr. Asquith, his own worst enemy, whose famous, "Wait and see," will be forgotten and forgiven only when the beautiful towns of Belgium shall have risen once more; Mr. Winston Churchill, the inefficient hustler, who breaks, like a bull in a china shop, through the work of experts, and who will be remembered by posterity only for his comic hats; Sir Edward Grey, the imitation sphinx, who has never yet in all his political life understood the very rudiments of diplomacy; Lord Haldane, whose vanity is like that of the toad and whose credulity is no less than that of the bumpkin who goes to the race-course and falls an instant victim to the confidence-man, —these men, and all their satellites without one exception, have quietly, steadily, and persistently made it possible for German militarism, German chemistry, and German effrontery to cause England to be the one country on earth whose name can never be mentioned again throughout the ages without raising the bitter ire of her friends. Oh, my God! to think that the little old man, scarred and battered with the wars of his country, left alive surely by an all-pitying Diety so that his magic voice might sink into the hearts and brains of his countrymen to prevent the sacrilege of civilization, should have lived in vain! His warnings and his appeals, which stirred the English nation from coast to coast, were scoffed at or ignored by the English politicians. The monthly reports of the secret services, all proving the criminal folly of the policy of laisser-faire, have been docketed away. The facts which have been plain to all the world, and caused France to strengthen her army and cut the terrible figures, 1870, on every one of her bullets. have been scorned by the English politicians. Instead of taking advantage of the anxious readiness of the country to subscribe to a system of compulsory service, they have steadily weakened the army and would have scuttled the navy had not their rudimentary knowledge of the nation's temper told them that such an act would have brought about a revolution. They knew of Germany's settled intention of declaring war when armed to the teeth. They knew that the day was drawing ever nearer when the peace of Europe would be broken by the roar of artillery. Every conceivable piece of evidence that daily accumulated on their desks made that fact plain and unanswerable. How, then, did they intend to act when overtaken by the inevitable? Take one look at the journal subsidized by them and find the answer. Not caring for or appreciating the country's sense of honor and pride, they intended to break their treaties and stand aside. They were going to say: "Let them fight who care to; we are unready, unwarlike. We will provide the loans at a high rate of interest and the ammunition at a price." Therefore I cry out aloud the sentiments of all true Englishmen when I say that the English party system is responsible for the war; because, had we been able to place a great army in Belgium to resist the German assault, there would have been no war. It was only because Germany knew of England's unreadiness, and was in the counsels of England's politicians, that she sprang at Belgium's throat.

> The mills of God grind slowly, yet they grind
> exceedingly small.

The germ of suicide would grow and grow in the brain of the thinking man did he not passionately believe that God does not intend this war to be just a hideous fracas, a blood-drunken orgy. The day will come when the warring countries, flung at one another by the leading villians of greed and selfishness and dishonesty, will flick the blood out of their eyes and ask one another the meaning of it all. The maimed and broken of all sides will look to see, in compensation for their lost limbs, the improving hand of the Master upon the churned-up earth. Out of her ruins France will rise with prayer upon her lips; Belgium, with her arms bared for the rebuilding of her smashed cities; and Russia with tears in her heart and brotherhood in her hands. In what manner Germany will be touched who can say? As for England, she, like a creature miraculously risen from the operating-table, will look out on the future with humbler eyes and a thankful heart. The cancer of the party system will have been cut out forever.

Looking through the smoke, I can see the House of Commons occupied by a small committee of unpaid men—business men, honest men. They would shudder to be called politicians. Their ambition is to earn the title of patriots. They belong to no party. They are the servants of the nation. They will not govern the country; they will guide it. They will pursue the same principles and methods for the restoration of her commercial strength as are employed by a committee of liquidation appointed by the court of bankruptcy to a broken business concern. They will run Great Britain in the simple way in which a great railway company is run, and their shareholders, the nation, will be content to read their statements of progress and receive their dividends. Phoenix-like from the ruins there will have risen honest men, and there will be no comfortable corner on this earth for those outcasts who once gambled with a nation's soul for money.

Winnipeg Sleet Storm Brings Down Towers

A sleet storm in Winnipeg, Man., early last month, resulted in the breaking down of one tower on the lines of the city's municipal transmission system, about 30 miles from the city, and caused about 2 miles of wire to be thrown off the towers of this system. The transmission line of the Winnipeg Electric Railway Company was broken in two

Sleet storm doubles up one of Winnipeg municipal towers.

places, but the damage, which was not so serious, was repaired by night time. The weather conditions were exceptional for that region, the sleet being of such thickness on the wires that the over-all diameter exceeded 2½ in. The cables of the municipal system have a total area of 275,600 circ. mils and are strung on towers such as the one shown in the accompanying illustration alternating with braced structures, spaced 600 ft. apart. The insulators are of the pin type and the wires are spaced on 6 ft. centres, six conductors per tower. The damage to the municipal system was such as to take twenty-three hours to repair it and place it in service.

Col. Mitchell Gets the D.S.O.

Hearty congratulations to Lieut. Col. Chas. H. Mitchell, who has been honored by a D.S.O. in recognition of distinguished and valued service as a General Staff officer in the First Canadian Division, and later, when he was promoted to the General Staff of the Canadian Corps, which includes all the several divisions now in France. Col.

Lt. Col. Charles H. Mitchell, D.S.O.

Mitchell's friends will appreciate that, inasmuch as the nature of his duties does not provide scope for spectacular work, this honor has been all the more difficult to obtain, and can only have resulted from the intense application of his well-recognized ability.

New Books

Reinforced Concrete Construction, Vol. II., Bridges and Culverts—prepared in the Extension Division of the University of Wisconsin by George A. Hool, S.B., Assistant Professor of Structural Engineering, and Frank C. Thiessen, B.S., Instructor in Structural Engineering, University of Wisconsin, with chapters and articles by other well-known writers. McGraw-Hill Book Company, Inc., New York, publishers; price $5 net. This volume, on Reinforced Concrete Construction, is devoted entirely to bridges and culverts, and will be followed by Vol. IV., containing a treatment of the remaining structures not already considered in Vols. I., II. and III. The present volume is an attempt to meet the needs of engineers in actual practice throughout the country. Intricate mathematical analyses have been avoided, but the work includes complete methods of design of both symmetrical and unsymmetrical arches, not only of single span, but of multiple spans with elastic piers. Two entirely different methods of arch analysis are presented in order that a check may be had on all arch computations. 682 pages, splendidly illustrated with 575 figures; stiff cloth covers; size of page 6 by 9 inches.

Trade Inquiries

1281. **Forgings.**—A Rugby firm would like to hear from manufacturers in a position to supply large forgings to specification.

1282. **Axles and tires.**—A Nottingham firm inquires for makers of wagon tires and axles to British clearing house specification.

1283. **Forgings.**—A Birmingham firm inquires for best quality forgings.

1284. **Springs and deals.**—A Rotherham firm inquires for railway wagon springs and deals for wagon building 7 by 2½ inches, 7 by 3 inches, 9 by 3 inches and 11 by 3 inches; also oak planks 12 by 5 inches in lengths from 15 feet to 17 feet 6 inches.

Personal

Mr. James L. Morris, C. E., has been appointed engineer for the township of Pembroke, Ont.

Mr. James J. Martindale, whose name has been so closely associated with Tuec Stationary Vacuum Cleaners in Ontario, is returning to the United States. The agency for Ontario has been purchased by Mr. C. B. Owens, who will carry the Tuec line of cleaners in addition to his present line of Powers temperature regulators.

The town council of Barrie, Ont., have appointed Mr. J. S. Laing engineer-assessor. Mr. Laing is a graduate of the University of Toronto in civil engineering. For the last two years he has been assistant engineer of the city of Galt and town of Preston, as well as engineer on the Galt, Preston and Hespeler electric railway. His experience thus covers many classes of engineering work.

Lieut.-Col. Davis, commanding the Second Pioneer Battalion, now in England, is seriously ill in the hospital at Winchester Camp with concussion of the brain, the result of his horse throwing him against a stone wall. Lieut.-Col. Davis is a former city engineer of Woodstock. He was in British Columbia when he offered to form a pioneer battalion, which he recruited partly in the Canadian West and partly in Ontario. He left for England shortly before Christmas.

Obituary

Mr. E. B. Jones, former city engineer of Chatham, Ont., died recently at Erie, Pa.

The death occurred very suddenly on January 16th of Mr. Thomas E. Baker, a popular citizen and prominent contractor of Prince Albert, Sask.

Mr. Peter Hunter, one of the builders to help in the erection of the first G. T. R. station at Montreal, a resident of Guelph for about forty years, and of Toronto for about twenty-two years, died on January 20th at the age of 91. He was born at Rawburn, Berwickshire, Scotland, in 1824, and came to Canada in 1848.

The death is announced of Mr. James Perry Sharp, of Briefond Moseley, Birmingham, England. Mr. Sharp was for many years the junior member of the firm of T. C. & J. P. Sharp, architects and surveyors, St. John, N. B. He afterwards removed to England, where he spent the remainder of his life. He was in his 73rd year.

Mr. G. Colin Carman, a civil engineer, of Cornwall, Ont., and one of its oldest and most highly respected residents, died on January 21, at the age of 79. The late Mr. Carman was engaged with the Canadian Pacific Railway in British Columbia when that road was being built. Later he was engaged on the engineering staff of the Cornwall canal, retiring about fifteen years ago.

Mr. John A. Wheaton, a veteran railway contractor, died suddenly on January 21st, at the age of 78. Mr. Wheaton was born at Wheaton Settlement, Westmoreland County, and in his early life started railway construction work. During his career he built the northern section of the I. C. R., the Inverness & Richmond Railway, Cape Breton; the Albert Railway; N. B. & P. E. I.; Cape Travers branch in Prince Edward Island; the Petitcodiac & Havelock; Moncton & Buctouche; the Central, from Norton to Chipman; also a portion of the Bangor & Aroostook. He retired from active life only a few years ago. For the last seventeen or eighteen years he had resided in St. John, N. B.

Mr. Hogarth Appointed Chief Engineer of Highways

Mr. George Hogarth, of the engineering staff of the Department of Public Works, Ontario, has been appointed Chief Engineer of Highways, succeeding Mr. W. A. McLean, who steps up to be Deputy Minister of the newly-

Mr. George Hogarth, O. L. S., Assoc. Mem. C. S. C. E.

formed Highways Department. Mr. Hogarth holds the degree of O. L. S. He is also an associate member of the Canadian Society of Civil Engineers, and is well known and highly thought of in engineering circles.

Mainly Constructional

East and West—From Coast to Coast

The city of Quebec has issued seventeen building permits of a value of $56,925 since the first of the year.

The Waterworks Department of the town of Barrie Ont., shows a surplus of $3,000 for the year just past.

According to the Halifax Morning Chronicle, building permits in Nova Scotia have increased substantially of late

The Ontario Good Roads Convention will be held in the York County Municipal Hall from the 22nd to the 24th of February.

Canada Nitro Products, Limited, is the name of a new Toronto concern organized with a capital stock of five million dollars.

Poole & Emery, Limited, contractors, Regina, Sask., are applying to change their style to Poole Construction Company, Limited.

About 300 reinforced concrete piles for use as the substructure of the Canadian Northern Railway wall across False Creek are being made by Creelman & Company, Vancouver. When enough piles are in hand work will be started on driving them in as foundations.

The Robert Simpson Company, Limited, will erect an eleven-storey building on Mutual Street, Toronto, to be used for the mail order branch of their business. The building will have a frontage of 279 feet and a depth of 115 feet, and will be 155 feet high. It will be absolutely fireproof, the floors being constructed of concrete and the main walls of reinforced concrete. The reported cost is about $500,000.

Anticipating that the opening of the new Royal Connaught Hotel will increase transient automobile traffic in Hamilton, and that Main Street will be the main thoroughfare for motors, several enterprising citizens are figuring on the construction of big garages and repair shops on that street, according to information handed out by Controller Cooper. It is hoped that the building trades will boom again in the spring.

Important harbor work is to be undertaken by the Public Works Department of Victoria, B. C., during the ensuing year. According to plans outlined by Mr. A. F. Mitchell, acting district engineer, at the annual meeting of the Victoria Inner Harbor Association, the Dominion Government propose during the present year to proceed with the dredging of the northwest passage, north of Pelly Island, between Songhees Point and Work Point, to provide a channel 300 feet wide, and with an average depth of twenty feet at low water.

The new Civic Improvement League of Canada was formally brought into existence at Ottawa on January 20th at a conference which opened in the Railway Committee Room of the House of Commons. His Royal Highness the Duke of Connaught opened the conference, and about 150 delegates from various parts of Canada were present. Mr Thomas Adams, the town planning expert, outlined the objects of the League—namely, the advancement of general civic improvement, the bettering of local forms of government, the drawing of town planning schemes, the re-planning of old districts on modern lines, the improvement of housing conditions in cities, the making and preservation of parks and open spaces in cities, etc., etc.

The case of the Russell Shale Brick Company against Henry J. Tharle, one of the contractors in the construction of the Ottawa Customs House, has been decided by Mr Justice Sutherland, the Russell Shale Brick Company receiving $7,000. The action arose out of an agreement to take brick from the company, which was not carried out. Ten of the fifty-four caissons to be sunk are now in place at the site of the new government piers at Victoria, B. C. It will be more than a year before this project nears completion. During 1915 the following work was done in connection with the contract: All earth and rock excavation has been practically completed. The amount of rubble dumped for the pier foundations is placed at 147,000 tons. Two thousand cubic yards of broken stone used for levelling off the foundations for the reception of the cribs has been deposited. Nine cribs were sunk into position during 1915. The "fill" for these cribs amounted to 13,000 cubic yards, and the "back fill," 82,000 cubic yards. In the construction of the nine cribs 11,000 cubic yards of concrete and 800 tons of steel were used.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Brooke Township, Ont.
Tenders will be received until 2 p. m., February 12th for extensions and repairs to the Parker Lucas and 15th Concession Drains for the Township Council. Plans and specifications at office of Commissioner W. J. Johnston, N. E. Quarter 10, Concession 10, Brooke.

Carleton County, Ont.
The County Council have decided to spend $60,000 on the construction of macadam roads. Clerk, Charles McNab, Nicholas Street, Ottawa.

Colchester South Township, Ont.
The Township Council will purchase a quantity of tile in the spring. Clerk, J. H. Madill, Harrow, Ont.

Dartmouth, N. S.
The Town Council contemplate the construction of water and sewer extensions on Upper Water and Mott Streets at an approximate cost of $3,000. Clerk, Alfred Elliott.

Egremont Township, Ont.
The Township Council will require a quantity of tile for drainage purposes this year. Clerk, David Allen, Holsein.

London. Ont.
The Board of Control are considering the installation of hydrants at an estimated cost of $5,000.

The City Clerk, S. Baker, will receive tenders until February 4th for the construction of about 3,900 feet of 15 and 12-inch sewer. Engineer, H. A. Brazier.

Niagara-on-the-Lake, Ont.
The Town Council are considering the construction of an 8-inch tile sewer on Prideaux Street. Engineer, James Brown.

Port Dover, Ont.
A report has been submitted to the Town Council by James Louden & Hertzberg, 79 Adelaide Street E., Toronto, dealing with two possible systems for water supply, estimated to cost $46,000 and $49,000. Clerk, James Sloan.

Ridgetown, Ont.
The Utilities Board of the Town Council are considering the extension of the waterworks system. Chairman, R. W. Stokes.

Sackville, N. B.
The Town Council intend to secure legislation to enable them to borrow $20,000 for paving on Lorne and Bridge Streets. Clerk, Thomas Murray.

St. John County, N. B.
The County Council contemplate the issue of bonds to the extent of $15,000 for paving. Secretary, J. King Kelly, Prince William Street, St. John.

Tecumseh, Ont.
The Ean Claire Water Works Company Ltd., intend to construct a waterworks system at an approximate cost of $20,000. About two miles of main will be laid.

Zurich, Ont.
The Town Council propose to complete the waterworks construction started last year. Clerk, F. Hess.

Railroads, and Bridges Wharves

North Dorchester, Ont.
The Township Council propose to build three bridges at an early date. Clerk, W. B. Lane, Dorchester, Ont.

Renfrew, Ont.
The Town Council contemplate the construction of a reserve dam at Golden Lake and have applied for the necessary permission. Engineer. J. R. Stewart.

St. Mary's, N. B.
Tenders on the construction of a steel bridge over the Nashwaak River will be received until February 23rd by the Hon. John Morissey, Minister of Public Works, Fredericton. Plans at the Department of Public Works.

Vancouver, B. C.
Plans have been filed with the Registrar for a wharf to be built in front of lot 892, Howe Sound, Westminster District, for the Britannia Mining & Smelting Company, Ltd.

Public Buildings, Churches and Schools

Birchcliffe. Ont.
In connection with the school now in course of erection for the Trustees of School Section No. 15, Scarboro, the contract for heating and plumbing has been let to T. A. Kent, Birchcliffe.

The Congregation of St. Nicholas Anglican Church intend to build a new edifice to replace that recently destroyed by fire. The architect will be appointed in the spring. Pastor, Rev. C. E. Luce.

Estevan, Sask.
Work is expected to start in the spring on the construction of a basement and chancel for the congregation of St. Mathews. Plans are now being prepared by J. Turner. Secretary, W. L. Thompson.

London, Ont.
The interior of the Salvation Army hall will be remodelled in the spring. Particulars from Ensign Martin.

The Department of Militia are considering the conversion of the hospital into a Home for Invalided Soldiers. Particulars from Colonel Shanon, London. Estimated cost, $5,000.

London Township, Ont.
The Trustees of School Section No. 23 propose to erect an addition to the school in the spring. Estimated cost, $3,000. Clerk, Mary Grant, 110 Dundas Street, Ont.

Otttawa, Ont.
The City Council have decided to have plans prepared for sun parlors. Architect not yet chosen.

Portage La Prairie, Man.
Plans and estimates are now being prepared for a two-storey, twelve-roomed school to be erected for the Public School Board. Work will start in the spring. Architect, Frank R. Evans, 130 Selkirk Avenue, Winnipeg.

Saskatoon, Sask.
Negotiations are now being carried on between the City Council and the Salvation Army with regard to the erection of an Industrial Home for Women. Headquarters of the Army, Toronto.

St. John County, N. B.
The County Council are considering plans for balconies at the County Hospital. Work will probably start shortly Estimated cost. $4,000. Architect, E. Neil. Brodie, 42 Princess Street, St. John.

Trenton, Ont.
The School Board are considering the erection of a High School and are obtaining options on a site. Chairman, S. J. Young, Dundas Street.

West Garafraxa Township, Ont.
The Trustees of School Sections Nos. 4 and 10 are considering the erection of schools. Secretaries. W. J. Philip, R. R. No. 3, Arthur, and J. A. Spence, R. R. No. 3, Arthur.

West Peace River, Alta.
The Trustees of School District No. 3,300 have been empowered to borrow $3,000 for the erection and equipment of a school. Secretary, Nelson Pinder, West Peace River.

CONTRACTS AWARDED

Drumbo, Ont.
The contract for plastering and plumbing in connection with the Presbyterian Church has been awarded to Charles H. Beckman.

Montreal, Que.
In connecton with the church basement which is now built on Rosemount Street for the Trustees of St. John Berchmans, 2619 Cartier Street, the contract for cut stone has been awarded to Alderic Cousineau, 2455 St. Urbain Street.

Business Buildings and Industrial Plants

Caledon, Ont.
A. McLeod contemplates the construction of a bank barn. Work will probably start shortly.

Chatham, Ont.
Work is progressing on the erection of a refinery on River Road for the Dominion Sugar Company, Wallaceburg, Ont. Engineer, John A. Shepherd. Approximate cost, $1,000,000.

Conroy, Ont.
E. Collins, Ailsa Craig, is considering the construction of new foundaions under his barns and other improvements.

Cottam, Ont.
The Imperial Bank propose to establish a branch. Manager, W. A. Clark, Essex.

Dundas, Ont.
Plans are being prepared by Martin E. Hewitt for an office and showroom building to be erected on King Street for the Public Utilities Commission. Brick construction. Estimated cost, $4,500. Chairman, R. W. Karch.

Fort William, Ont.
J. R. Tucker has decided to rebuild his store which was recently destroyed by fire.

Hamilton, Ont.
The painting required in connection with the factory which has been built on Hughson Street W. for the T. Eaton Company, Toronto, will be done by the owners.

Hespeler, Ont.
John Limpert intends to remodel two stores and convert them into one large store.

Lanigan, Sask.
Tenders on the erection of a creamery will be received until noon, February 20th, by the Lanigan Creamery Company, Ltd. Plans and specifications with the owners and at the office of the Dairy Commissioners, Government Buildings, Regina.

London, Ont.
The proposed extensions to the premises of Smallman & Ingram, Dundas Street, will include the installation of a steam heating plant. Architects, Watt & Blackwell, Bank of Toronto Building.

The Peerless Hosiery Company will shortly call for tenders on the installaton of heating and plumbing in connection with their factory. Architect, A. E. Nutter, Dominion Bank Building.

Plans are to be prepared for a warehouse to be erected for Gootson Bros., 28 Maitland Street. Architects, McBride & Gilbert, Edge Block. Approximate cost, $5,000.

Montreal, Que.
Plans are being prepared for a factory to be erected for the Northern Electric Company, 121 Shearer Street. Steel and corrugated iron construction, concrete foundation.

Niagara Falls, Ont.
Plans for a factory are to be prepared immediately for the Oneida Community, Ltd., Oneida, U. S. A. Particulars from A. Reeves.

North Vancouver, B. C.
The erection of a fire hall has been recommended by Fire Chief Findlay. Municipal Clerk, J. Collins.

Port Stanley, Ont.
The London & Port Stanley Railway Board will start work in the spring on the construction of a waiting room in connection with the Incline Railway. Secretary, William Spittal, c/o People's Loan Company, London.

Sparta, Ont.
Plans are being prepared for two fireproof dairy barns to be erected for John Rundle, Sparta Road. Work will start in the spring. Estimated cost, $7,000.

Toronto, Ont.
Tenders on structural steel required in the rebuilding of the Princess Theatre will be received until February 5th and on all other trades until February 12th by the Assocoiate Architect, C. J. Read, 203 Confederation Life Building. Estimated cost, $100,000.

The Hamilton Gear & Machine Company, 15 Van Horne Street, have received tenders on the erection of an addition to their premises and will let contracts shortly. Steel, brick and mill construction. Approximate cost, $5,000.

Work is about to start on the erection of a warehouse and factory at 64-66 Princess Street for the Laura Secord Candy Company,—proprietor, F. P. O'Connor, 354 Yonge Street. Brick construction. Approximate cost $15,000.

Trail, B. C.
The City Council are considering the erection of a fire hall and the installation of an alarm system. A site will be secured and plans prepared. Clerk, William Monypenny.

Vancouver, B. C.
The American Can Company, 535 Railway Street, will receive tenders until February 10th for the erection of an addition to their premises. Heating will be tendered upon separately.

Vienna, Ont.
The Vienna Cheese Company propose to lay cement floors in their factory. Work will start shortly.

Wallaceburg, Ont.
The Town Council contemplate the reroofing of the pump house. Material not yet chosen. Clerk, C. B. Jackson.

Winthrop, Ont.
Melvin Blanchard, Seaforth, Ont., is preparing plans for farm buildings, estimated to cost $3,000. Frame and reinforced concrete construction, concrete foundation.

CONTRACTS AWARDED

Galt, Ont.
The general contract for the erection of an addition to the warehouse of the Canadian Cereal & Flour Mills Company, Ltd., has been awarded to George Murray, 32 Richardson Street.

Hamilton, Ont.
Work has been started on the erection of an addition to the offices of the National Steel Car Company, Kenilworth Avenue. The general and steel work contracts have been let to G. E. Mills, King Street E., and the masonry to George White, 165 Main Street E. Estimated cost, $10,000.

Montreal, Que.
Work has been started on the erecton of a store and a number of residences for E. Gagnon, 525 Dandurand Street. The general, masonry and carpentry contracts have been let to H. Debarret, 274 Fourth Avenue, Rosemount Ward. Tenders on other trades are being received by the general contractor. Approximate cost, $6,000.

Brandrom-Henderson, Ltd., 2984 St. Urbain Street, have let the general contract for interior alterations to their factory to John Allan, 300 Atwater Avenue. Approximate cost, $5,000.

In connection with the store and residence which have been built by David Sirois, 145 Hamilton Street, the contract for plastering has been let to A. Brisgois, 112 Dumas Street, and the plumbing to Emile Cote, 97 Boulevard Monk.

Ottawa, Ont.
The general contract for alteration to premises on Rideau Street for Mrs. O'Keefe has been awarded to P. J. Ellement, 624 Cooper Street. Brick construction, felt and gravel roofing. Estimated cost, $5,000. Architect, F. C. Sullivan, Castle Building, Queen Street.

The general contract for the erection of a store and residence on Nelson Street for Mrs. S. Coplan, 27 Stewart Street, has been awarded to S. Coplan, 27 Stewart Street. Brick veneer construction, concrete foundation, felt and gravel roofing. Estimated cost, $4,000.

Work has been started on razing the premises at 195 Bank Street preparatory to the erection of a store for S. E. Luke et al, 59 Rideau Street. General contractors, J. & C. Low, 358 Lisgar Street. Frame and brick construction, felt and gravel roofing.

Sault Ste. Marie, Ont.
In connection with the alterations now being carried out at the premises of the F. W. Woolworth Company, Ltd., the contract for fixtures has been let to Jones Brothers Company, Ltd., 31 Adelaide Street W., Toronto, the electrical work, heating and plumbing to Cochrane Hardware Company, Ltd., 388 Queen Street E., and the painting to E. T. Grand, Queen Street.

Toronto, Ont.
The general contract for the erection of a workship at 105 Berkley Street has been let by H. S. Kaplan, Architect, 75 Macdonnell Avenue, to Schier & Lachman, 93½ Grance Avenue. Contracts not yet awarded for plumbing, elevator and sash steel sash. Estimated cost, $3,000.

In connection with the addition which is being built at the premises of the Smith Manufacturing Company, 201 Front Street E., the carpentry contract has been awarded to Charles Fry, c/o W. G. Burns, architect, 74 Indian Grove Avenue.

Residences

Dundas, Ont.
Charles E. Dickson has purchased a site on Sydenham Street for the erection of a residence, and will have plans prepared. Estimated cost, $4,000.

Edmonton, Alta.
Duncan C. Scott, Department of Indian Affairs, Otttawa, will receive tenders until noon, February 28th, for the erection of twenty houses for Enoch Band-Edmonton Agency. Plans and specifications at the Dominion Lands Office, Edmonton, with George H. Race, Agent, Edmonton, and at the Department

Harrow, Ont.
The erection of a residence is being considered by Louis Quick. Estimated cost, $3,000.

Lanark, Ont.
Rev. R. A. Carey, Lanark, will receive tenders until February 5th for the erection of a residence. Architect, F. C. Sullivan, Castle Building, Queen Street, Ottawa.

London, Ont.
Plans are being prepared for a residence to be built on Dufferin Avenue For D. C. McNaughton, c|o McCormick Manufacturing Company. Architects, Watt & Blackwell, Bank of Toronto Building. Stucco construction, stone and concrete foundation, shingle roofing. Estimated cost, $4,000.

James Black, c|o Grigg House, is considering the rebuilding of his residence, which was recently destroyed by fire. Estimated cost, $3,000.

J. H. Wilkey, 537 Ontario Street, is having plans prepared for a residence, estimated to cost $4,000. Ded pressed brick construction, concrete foundation, shingle roofing.

Plans are to be prepared for remodeling four residences for Gootson Bros., 28 Maitland Street. Work will include foundations, brick veneering, furnaces and interior alterations. Approximate cost, $5,000.

W. Hill, manager of the Home Bank, intends to have plans prepared for a residence to cost about $5,000.

Sutherland Bros., 73 Dundas Street, are about to prepare plans for a residence, estimated to cost $3,500.

The erection of a residence is contemplated by John Hayman & Sons, 32 Wellington Street. Plans will be prepared. Estimated cost, $5,000.

Montreal, Que.
L. A. Jalbert, 245b Chambly Street, is building four flats on Stadacona Street, estimated to cost $3,500. Artificial stone construction, concrete foundation, felt and gravel roofing.

All work required in connection with the flats which are being built on St, Denis Street by J. A. Bray, 6375 Berri Street, is being done by day labor.

Ottawa, Ont.
Alexander Abraham, 619 Booth Street, has commenced rebuilding his residence. Work is being done by day labor.

Port Stanley, Ont.
Work is about to start on remodelling a residence for Harley Taylor. Work consists of interior alterations.

Sydney, N. S.
Tenders will be called in the spring on the erection of a residence on Kings Road for the Dominion Coal Company. Architect, F. W. Spencer, 200 Charlotte Street.

Toronto, Ont.
R. Doherty, 56 St. Andrews Gardens, has commenced the erection of a residence at 481 Summerhill Avenue. Masonry and smaller trades will be let. Brick construction, shingle roofing. Estimated cost, $3,000.

The Reliance Building Corporation, Royal Bank Building, have commenced the erection of a pair of residences at Gerrard and Street and Glenmount Park Road. Smaller trades wll be let. Brick construction, shingle, felt and gravel roofing. Approximated cost, $4,000.

Work has been started by R. J. Linton, 24 Howard Street, on the erection of a residence at Iroquois and Cherokee Avenues at the Island. Frame construction, shingle roofing. Estimated cost, $3,000.

Plans have been drawn for a pair of residences to be built by J. Bennett, 143 Caledonia Road. Smaller trades will be let. Brick construction, shingle, felt and gravel roofing. Estimated cost, $3,500.

Work has been started by E. C. Hurlburt, 44 Castlefield Avenue, on the erection of a residence in St. Stibbard Street. Smallr trades will be let. Brick construction, shingle roofing. Approximate cost, $3,000.

Wallaceburg, Ont.
Bert McKim is about to prepare plans for a residence to be erected in the spring at an approximate cost of $3,000.

Windsor, Ont.
Plans are being prepared for a residence to be built on Dougal Avenue for William Weir, 111 Windsor Avenue. Tenders on the construction will be received until February 12th. Architects, Leybourne & Sewell, Sandwich Street E. Brick construction, concrete foundation, shingle roofing. Approximate cost, $5,000.

Mrs. G. Hallett, Langlois Avenue, is having plans prepared for flats, estimated to cost $8,000. Tenders on the construction will be received from February 8th to 20th. Brick construction, shingle roofing. Architects, Leybourne & Sewell, Sandwich Street E.

Winthrop, Ont.
Thomas Wheatley, Seaforth, Ont., is preparing plans for a residence, estimated to cost $4,000. Red pressed brick construction, concrete and stone foundation.

CONTRACTS AWARDED

Montreal, Que.
In connection with the residence which is being built on La Salle Avenue by J. T. Legault, 30 St. James Street, the contract for painting has been awarded to R. Limoges, 51 Orleans Avenue, and the plumbing to W. Theriault, 283 William David Street.

The following contracts have been let in connection with the flats in course of erection for G. . W. Zwinge, 296 Madison Avenue:—brick work, Vilonga & Simon, 599 St. Christopher Street; plastering, Z. Bouchard, 12 Bourget Street; painting, Martin & Montgomery, 556 Madison Avenue; heating and plumbing, E. Wiliams, 217 Marcil Avenue. Roofing and electrical work not yet awarded.

Ottawa, Ont.
The following contracts have been let in connection with the residence which is being built on Grove Street for G. E. McMenemy, 40 Roslyn Avenue:—brick work, F. W. Jackson, 790 Bronson Street; roofing, A. P. Herbert, 613 Albert Street; heating, O'Hara Bros., 170 James Street; plumbing, H. Knox, Elgin Street. Plastering not yet awarded.

The contract for heating and plumbing required in connection with the residence which is being erected on Hopewell Avenue by A. W. Davidson, 69 Grosvenor Street, has been let to Gervin & Lillico, 1093 Bank Street, and the electrical work to the Dominion Electric Construction Company, 477 Sparks Street.

Westboro, Ont.
J. A. Leech, Main Street, Highland Park, is building a residence on Richmond Road, estimated to cost $3,500. The contract for electrical work has been awarded to H. L. Allan, 377 Somerset Street, Ottawa. Brick veneer construction, concrete foundation, shingle roofing.

Power Plants, Electricity and Telephones

Calgary, Alta.
Tenders on the supply of switchboard equipment will be received until 1 p.m., February 14th, by the City Clerk, J. M. Miller. Specifications, etc., at office of the City Electrical Engineer, City Hall.

Cedoux, Sask.
The Cedoux Rural Telephone Company have been empowered to borrow $3,000 for the construction of their system. Treasurer, C. Berma, Cedoux.

Dereham Township, Ont.
The Township Council propose to instal light and power systems as soon as possible. Particulars from C. H. Denton, Tillsonburg, Ont.

East Williams Township, Ont.
The Township Council propose to secure estimates from the Hydro Commission on the cost of an electric line from Granton to Arkona. Clerk, W. McCallum, Nairn.

Elora, Ont.
The Town Council are considering the construction of an electric line to Salem for the supply of power to that village and intermediate points. Superintendent, Henry Clarke.

Khedive, Sask.
Permission has been granted to the Khedive Rural Telephone Company to borrow $6,500 for the construction of their system. Treasurer, J. G. Farnum, Khedive.

London, Ont.
The Utilities Commission have decided to purchase three 250 kv.a. transformers and switchboards. Chairman, Philip Pocock.

The Bell Telephone Company are preparing plans for installing their lines in underground conduits. Manager, C. H. Beard.

The City Council have been petitioned to construct an ornamental lighting system on Wellington Boulevard. Clerk, S. Baker.

McGillivrary Township, Ont.
The Township Council have asked the Hydro Commission for estimates on the cost of a line through McGillivray from Lucan to Grand Bend. Clerk, J. D. Drummond, Ailsa Craig.

North Vancouver, B. C.
Fire Chief Findlay has recommended the installation of an alarm system of 35 boxes, or as an alternative, the purchase of three pieces of motor equipment. Municipal Clerk, J. Collins.

Ontario Province.
The Canadian Pacific Railway Telephone Company, Montreal, propose to run a new copper wire line between London and Toronto.

St. Thomas, Ont.
The Hydro Electric Commission, City Hall, are receiving tenders on the supply of two transformers, 750 kv. a., 3-phase. Superintendent, E. H. Coughell, City Hall.

Tillsonburg, Ont.
The Town Council propose to extend their system to supply light and power to farmers in the district. Superintendent, J. Teckoe.

Weldon, Sask.
The Weldon Rural Telephone Company, Ltd., propose to construct their system as soon as possible. Secretary, C. O. Heggveit.

Fires

Cookville, N. B.
Fire has totally destroyed the barns owned by C. Fred Cook. Loss, $2,000, no insurance.

Cormac, Ont.
St. Anne's Church has been entirely destroyed by fire. Loss, $10,000, insurance, $5,000.

Esquimalt, B. C.
The premises of the Esquimalt Brewing Company on the Viewfield Road have been entirely destroyed by fire. Loss, $20,000. The Company propose to rebuild immediately on more substantial lines.

Fort Frances, Ont.
The business block owned by the Great West Supply Company and F. J. Strain has been destroyed by fire. Loss to the former, $22,000.

Fort William, Ont.
Fire has destroyed the boarding house owned by T. H. Roberts, 126 Bethune Street. Loss, about $9,000, partially covered by insurance.

Fredericton, N. B.
The Presbytery has been damaged by fire to the extent of about $4,500, which is partly covered by insurance. Pastor, Rev. J. R. D. Cowie.

Merritt, B. C.
The office building of the Middlesboro Collieries Ltd., has been destroyed by fire. Loss, $10,000, partly insured.

Montreal, Que.
The business block at 91 otre Dame Street W., owned by Tom Gallagher has been damaged by fire to the extent of between $10,000 and $15,000.

Morewood, Ont.
Fire has completely destroyed the residence of Arthur Swerdferger.

Pefferlaw, Ont.
Fire has totally destroyed a barn owne
Fire has totally destroyed a barn owned by David Godfrey.

Port Hope, Ont.
Fire has destroyed the store and residence owned by Albert Hugh, Sullivan Street. Loss is partialy covered by insurance.

Port Stanley, Ont.
Fire has badly gutted the Hotel Loney, owned by Arthur Sadlier. Loss $15,000.

St. Honore, Que.
The Convent of the Sisters of Charity has been destroyed by fire. Loss, $18,000, insurance, $12,000. The Convent will be rebult.

Toronto, Ont.
Fire has damaged the premises of R. Barron Ltd., 724 Yonge Street. Loss on building and contents, $2,500, covered by insurance.

Damage to the extent of $5,000 has been caused by fire at the premises at Yonge and Richmond Streets, owned by Ambrose Kent & Sons, Ltd., 156 Yonge Street.

Wainwright, Alta.
The mill of the Wainwright Milling Company has been entirely destroyed by fire. Loss, $28,000, covered by insurance.

Walkerton, Ont.
Fire has completely destroyed two residences owned by Mrs. Wisler, West End Bridge, Walkerton. Owner is considering rebuilding.

Waterloo, Que.
The Hotel Canada, owned by P. L. Nadeau, has been damaged by fire.

Miscellaneous

Hagersville, Ont.
Frank Tyrrel, builder, is receiving prices on all kinds of building material, concrete mixers and woodworking machinery.

Hull, Que.
The City Electrician, R. Trudel, has recommended the purchase of an automobile truck, owing to the large territory covered by the system. City Clerk, H. Boulay.

London, Ont.
The Victoria Amusement Company, c/o G. Holding, Princess Winter Garden, have decided to instal an aerial swing, erected on steel work and operated by hydro power. Estimated cost, $3,500.

Lucan, Ont.
Frank Booth, c/o J. H. Walls, contemplates the equipment of his creamery with new machinery at an estimated cost of $7,000.

Montreal, Que.
Tenders on the supply and delivery of asphalt will be received until noon, February 21st, by the Board of Commissioners. Specifications at office of the Superintendent of Purchases and Sales, and the Engineers Department.

H. Paiement, builder, 1335 Gouin Boulevard, is receiving prices on brick, cement, steel, metal lath, store fronts, star and double diamond glass, paint, plumbing fixtures, reinforcing bars and lumber.

New Glasgow, N. S.
Tenders on the construction of timber lock gates and equipment will be received until 4 p. m., February 28th, by R. C. Desrochers, Department of Public Works, Ottawa. Plans and specifications at office of the District Engineers at Antigonish, N. S., Halifax, Montreal, (Shaughnessy Building), Toronto, (Continental Life Building), and with the Postmaster, New Glasgow.

Ottawa, Ont.
The Dominion Department of Public Works, Ottawa, will receive tenders until 4 p. m., February 15th, for sundry supplies required by the Departmental Dredging Plant in Ontario and Quebec, including hardware, chain, paint and oils, wire rope, steam pipe, valves and fittings. Specifications at the Department.

CONTRACTS AWARDED

Niagara Falls, Ont.
The City Council have awarded the contract for supply of cast iron pipe to Gartshore-Thomson Pipe & Foundry Company, Stuart Street, Hamilton. Contract for valves and brass work will be let later.

Construction of Largest Drydock Will Require Use of Varied Plant

The new South Boston drydock is to be the largest in the country, being 1200 ft. by 149 ft. in over-all dimensions. A wide variety of plant, including cableways, locomotive cranes, compressor plant for drills, mixing plants, a variety of floating plant, and, indeed, about everything but steam shovels, will be used by the Holbrook, Cabot & Rollins Corporation in carrying out the contract.

A dredge is already at work on the site of the dock proper, and Morris & Cummins, of New York, who have this part of the work or a sub-contract, are expected to bring up one of the biggest dredges on the Atlantic coast which can handle 150,000 cu. yds. of material per month, and which will make short work of the 450,000 cu. yds. to be dredged from the dock site proper and dumped at sea.

Two large areas of land, between which lies the site of the dock and approach channel, have already been made by filling in between recently constructed bulkheads. The balance of this fill will be made, after the dock is finished, from the material dredged out of the approach channel. This material will also be used to complete the fill between the bulkheads and the dock walls, after a heavy bank riprap to be excavated from the dock floor has been placed around the outside of the walls.

About 85,000 cu. yds. of rock must be excavated all over the dock floor. Considerable saving has been effected in the design by the plan of excavating beneath the walls only enough to secure a solid foundation, a sloping blanket of concrete joining the toe of each wall to the floor concrete of the dock.

The Directors of the Port of Boston designed the dock and will supervise its construction. Edward F. McSweeney is chairman and Roert E. Barrett chief engineer. DeWitt C. Webb, civil engineer, U. S. N., has been detailed by the Navy Department at the request of the Boston board to assist in the design and supervision of the work.

The contractors will spend the time until the dock site is dredged assembling plant. Then a cofferdam will be thrown across the lower end of the site as indicated, and the water pumped out. Active work on removing the rock will not start before the middle of next spring. The work is under the direction of Mr. Rollins, of the contracting firm, but the name of the man who will have direct charge of the construction has not yet been given out.

Tenders and For Sale Department

TENDER
Annual City Supplies

Sealed tenders will be received by the undersigned, addressed to Chester S. Walters, Esq., Mayor, chairman Board of Control, City Hall, Hamilton, Ont., up to five o'clock p.m. on **Wednesday, March 1st, 1916**, for supplying the Corporation of the City of Hamilton with the following:-

Cement; Broken Stone and Screenings; Limestone Dust; Asphalt; Asphalt Sand; Sand and Gravel; Vitrified Brick; Creosoted Wooden Blocks; Lumber; Sewer Pipe; Sewer Brick; Lime; Castings (Ordinary and Special); Iron Pipe; Hydrants; Valves; Extension Boxes; Lead Pipe; Pig Lead; Rubber Hose; Rubber Boots; Road Oil; Lubricating Oil; Flux; Fuel Oil; Coal Oil; Gasoline; Concrete and Garbage Duck Covers; Bass Brooms; Sectional Sweepers; Brass Work, including ordinary and special brass castings for Water Department; Hardware.

Tenders to be on forms supplied, and plainly marked on the outside "Tender for Cement," or as the case may be.

Specifications and form of tender for all of the above can be obtained at the office of the City Engineer, Hamilton, Ont.

A marked cheque for 10 per cent. of the amount of tender (unless otherwise stated in specifications), payable to W. R. Leckie, City Treasurer, must accompany each tender, which will be forfeited should the tenderer and his sureties fail to execute contract within four days after notice of acceptance by the City.

The lowest or any tender not necessarily accepted.

S. H. KENT,
City Clerk.

Hamilton, January 28th, 1916. 5

Separate sealed tenders, addressed to the undersigned, will be received at this office until 4 p.m., on **Tuesday, February 15, 1916**, for the supply of: "Brooms and Brushes," "Chain," "Coal," "Hardware," "Hose," "Oils and Greases," "Packing," "Paint and Paint Oils," "Manilla Rope," "Wire Rope" and "Steam Pipe, Valves and Fittings," for the requirements of the Departmental Dredging Plant in Ontario and Quebec during the fiscal year 1916-1917.

Each tender must be sent in a separate envelope and endorsed: "Tender for Hardware, Ontario and Quebec," "Tender for Chain, Ontario and Quebec," etc., etc., as the case may be.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures. These forms can be obtained at the Department of Public Works, Ottawa.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, for amount stated in form of tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the contract. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, January 21, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—90556. 4-5

Tenders Wanted

Sealed tenders for all trades, with the exception of structural steel, in connection with the erection of the New Princess Theatre, Toronto, will be received until 5 p.m., **Saturday, February 12, 1916**, at the office of the undersigned.

Structural steel tenders will close at 5 p.m., Saturday, February 5, 1916.

Tenders to be submitted on forms to be supplied.

Plans and specifications may be seen at the office of Charles J. Read, Rooms 203-4 Confederation Life Building, Toronto, Ont.

C. HOWARD CRANE, Architect,
CHARLES J. READ, Associate Architect.
4-5-6

Sealed tenders addressed to the undersigned, and endorsed "Tender for Lock Gates at East River Lock, N.S.," will be received at this office until 4 p.m., on **Monday, February 28, 1916**, for the construction of Timber Lock Gates and their equipment for the East River Lock, near New Glasgow, Pictou County, N.S.

Plans and forms of contract can be seen and specification and forms of tender obtained at this Department, and at the offices of the District Engineers at Antigonish, N.S.; Halifax, N.S.; Shaughnessy Building, Montreal, P.Q.; Confederation Life Building, Toronto, Ont., and on application to the Postmaster at New Glasgow, N.S.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

NOTE.—Blue prints can be obtained at the Department of Public Works by depositing an accepted bank cheque for the sum of $20.00, made payable to the order of the Honourable the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, January 27, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—91583. 5-6

For Sale

Large manufacturing company in the United States specializing in concrete machinery wants to sell outright a full set of drawings, patterns, and other information in reference to building and marketing concrete mixers. Good opportunity for Canadian manufacturer. Box 296, Contract Record and Engineering Review, Toronto, Ont. 4-6

POSITIONS VACANT

CITY ENGINEER WANTED.—Applications for position of city engineer will be received until **March 1st, 1916**. Salary, $1,800 per annum. Send copies, not originals, of references, etc. Jos. McCartney, City Clerk, Galt, Ont. 5-6

AGENTS WANTED

Canadian sales agents wanted by large company manufacturing road making and contractors' machinery. Box 297, Contract Record and Engineering Review, Toronto, Ont. 4-7

Late News Items

Amherstburg, Ont.

The Town Council have instructed Mayor Auld to secure prices on the supply of a switchboard and transformers.

Hamilton, Ont.

The Board of Control will receive tenders until 5 p.m., March 1st, on the supply of materials for building, roadways and waterworks construction. Specifications at office of the City Engineer.

London, Ont.

The City Council propose to lay a large number of pavements this season, at an approximate cost of $75,000. Engineer, H. A. Brazier.

Plans are being prepared for remodelling the Hall of the Salvation Army. Work will include a new front, metal ceilings, boilers for steam heating and seating. Architect, Brigadier G. Miller, Albert Street, Toronto. Approximate cost, $15,000.

The Hydro Commissioners propose to spend $12,000 on the purchase of meters and other devices and to construct steel towers, wires and cables at an estimated cost of $24,000. General manager, E. V. Buchanan.

Montreal, Que.

Fire has destroyed the business block at 238-242 St. James Street. Loss, $8,000. The owners are an Estate in England and nothing will be done until word is received from them.

Tenders on the supply of round elm, round maple, douglas fir and hemlock railway ties will be received until noon, February 10th, by the Secretary to the Harbor Commission, David Sheath, 57 Common Street. Specifications at office of the Engineer, F. W. Cowie.

The general contract for the erection of a residence on Marlowe Street for A. H. Brittain, 3 St. Nicholas Street, has been awarded to Anglin's Limited, 65 Victoria Street, and work has been started. Brick construction.

Ottawa, Ont.

The Department of Public Works have let the contract for the construction of a retaining wall and other works in connection with the Customs Building to P. Lyall & Sons Construction Company, Limited, 120 St. James Street, Montreal. Approximate cost, $22,630.

ESTABLISHED 1886

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Principal Contents

Give the Engineer Authority

"The proof showed that some of the employees under the engineers of the city had no competency whatever. They were **appointed without the sanction or knowledge of the engineers,** who had **no authority** to dismiss them or **to deal with them in any way** at all."

The above statement is made by Mr. Justice Croquet in a judgment just handed down in Montreal, in which it had been shown that the city had lost $80,000 on one single sewer contract as a result of incompetence and inadequate inspection due to lack of authority of the head of this department to remedy these matters. It was further shown that the chief engineer had tried to rid his department of one especially undesirable inspector, but that the latter was reinstated by council. Being dismissed a second time, this inspector then procured a letter from the Mayor of Montreal "ordering" his re-reinstatement.

Yet, in the face of these circumstances, Justice Croquet comments, "when anything goes wrong the chief engineer is the first man who is sought out and held responsible."

And how many of our municipalities could honestly throw stones at Montreal? Isn't this just typical of conditions in numberless cities and towns all over the Dominion? Aren't our engineers continually subjected to the petty authority of temporary elective officials who secure their brief hold on office, nine times out of ten, through "influence" of one kind or another? Don't we every day watch the humiliating spectacle of the trained, competent and efficient man subjected to the whims and made the tool, of some miserable party grafter? To the man who appreciates fair play and honest dealing it is a sickening sight to see our national honor so often apparently made subsidiary to the expediency of rascals, to see dishonesty overrule honesty, incompetence dominate competence, and ignorance browbeat knowledge.

There is no shadow of doubt that infinitely more of our municipal undertakings fail through interference of councils, mayors, etc., than through any fault of the engineers in charge of construction or operation. This fact is not sufficiently well known to the average citizen, however. He is so saturated with the conviction, the product no doubt of his political experience, that all men of that type are grafters, that he does not recognize in the engineer a different class of individual. Why is this? Largely because honesty and ability and modesty go together. The engineer is not an advertiser. He is not a public-spirited man in the usual sense—perhaps not public-spirited enough. His work and studies absorb his whole time. Politics, like golf, is, he believes, a game for the leisurely classes.

The latest statement of Dominion finances, covering the period from April 1, 1915, to February 1, 1916, shows an increase in revenue from all sources of approximately $30,000,000 as compared with the same period a year ago. Also, expenditures have been reduced by $18,500,000. Our revenue position for 10 months is therefore improved to the extent of $48,500,000 as compared with the same period of 1915, or at the rate of $58,200,000 a year.

We believe this has got to change. The engineer must assert himself. His ability, his knowledge, his experience, his training in making impartial judgments, must be advertised. He must do it himself, too, even as others, without these same wares in stock, nevertheless advertise them just the same. The world values a man, after all, largely at his own estimate—must do so until at least they have a chance to form their own judgments—and therefore it appears to be the plain duty of the engineer to be more self-confident, more assertive, more aggressive, more insistent of his ability to do well what others, badly equipped, are doing badly.

When this European war is over a bigger one will begin—it will be a **war of efficiency**. From the lowest ranks to the highest office in this new army there will be no place for the incompetent, or—we lose. Is our system of government—municipal, provincial, Dominion—as at present constituted, likely to make Canada a factor in such a war?

Montreal Good Roads Congress

As already announced in an earlier issue of the Contract Record, the third Canadian and International Good Roads Congress will be held at Sohmer Park Montreal, from Monday, March 6, until Friday, March 10. The decision to hold the congress in war time was reached by the committee on two grounds—first, that the provincial governments are continuing their good roads policy, and that therefore the interchange of views on roadmaking should not be interrupted; and, second, because of the slogan of the Association, which is "Good roads are a national asset, and form part of the defence works of a nation." The aims and objects of the congress are to interest the people at large in the principle of good roads, and to disseminate knowledge regarding the best methods of securing them. To this end the programme of the congress will year by year become less general and more specific, so that, instead of vaguely advocating the merits of good roads, the addresses will be chiefly by speakers particularly qualified to discuss the various aspects of roadmaking—finance, legislation, traffic, location, drainage, foundations, wearing surfaces, binders, maintenance, equipmet, municipal improvements, bridges, culverts, and so on. Some thirty thousand invitations are being sent out, and plans are being prepared to accommodate at least two thousand delegates from various points in Canada. Sohmer Park is one of the largest and most commodious buildings in the city of Montreal. The ground floor of 25,000 square feet will be given over to the Good Roads Exhibition being held in connection with the congress, where practically everything involved in the making of roads will be on display. A large convention hall upstairs will provide ample space for the business and educational sessions of the congress. Further information may be obtained from Mr. George A. McNamee, secretary-treasurer, Dominion Good Roads Association, Montreal.

Canadian Waterpower Researches

"Substantial progress has been made by the various organizations of the Dominion and Provincial Governments in investigating the water resources of the Dominion. The only province that is not now provided with some form of water resources investigation is New Brunswick, but negotiations, now under way, will probably lead to some satisfactory arrangement in the near future. Manitoba, Saskatchewan, Alberta and British Columbia have permanent systematic hydrographic organizations under the direction of the Minister of the Interior. Ontario is gradually being covered by the hydraulic division of the Ontario Hydro-Electric Power Commission. Quebec is being looked after by the Quebec Streams Commission and the chief engineer of Hydraulic Forces. In Nova Scotia there is a co-operative agreement between the Dominion Water Power Branch of the Department of the Interior and the Nova Scotia Water Power Commission. The field investigations of these organizations are being published in a very satisfactory form, although there has been some delay in publishing the data promptly, following the completion of the calendar or water year, as the case may be. The chief engineers of the above organizations have had several informal conferences with a view to co-ordinating, systematizing and standardizing their work, and also to facilitate the publication of the data in a uniform way and promptly. The net result of these informal discussions will be that in the near future, Canada will be completely covered by efficient and effective organizations charged with the responsibility for investigating, in the most complete and comprehensive manner consistent with the dictates of economy, the water resources of the Dominion."—M. James White before C. S. C. E., annual meeting.

The Kaministiquia Power Company

For completeness of installation and continuity of service the Kaministiquia Power Company has few equals, in hydro-electric power developing stations in Canada to-day. The plant is situated at Kakabeka Falls, and delivers its entire output to the twin cities of Port Arthur and Fort William. These cities, at the head of Lake Superior, occupy a strategical position in the commerce of Canada, being the transfer point between the east and west. West-bound merchandise is here transferred from boat to rail, or stored for delivery during the winter months, and east-bound grain, forest and mineral, raw products forming the return cargo are transferred from rail to boat. The transfer facilities required to handle this immense traffic must necessarily be the most reliable obtainable. Electricity has been almost totally used; power being obtained from the Kaministiquia Power Company.

After nine years of operation the company shows a record for service continuity that, we believe, is not surpassed by any other plant in Canada. Trouble, inconvenience, or delay from ice, backwater, or water shortage, are unknown, and from all causes the total interruptions to the system have not exceeded twenty minutes in any one year. During the past year this record was reduced to four minutes.

The plant, which is now complete, has a total development of approximately 30,000 h. p. The original installation was commenced in 1905, was enlarged in 1911, and completed in 1915. The details of additions, which consist of a reinforced concrete aqueduct one and a quarter miles long; the installation of butterfly valves as headgates to penstocks, with their control apparatus; erection of a steel penstock, a 12,500 h. p. turbine, and a 9,375 kv.a. generator with the necessary transformers, switching apparatus, etc., are explained in detail elsewhere in this issue.

Plan to Dredge New Inner Harbor Channel at Victoria, B.C.

Plans for a channel that will afford an entirely new passage into the inner harbor at Victoria, B. C., were discussed at the ninth annual meeting of the Victoria Inner Harbor Association, held in that city on January 11. A. F. Mitchell, acting district engineer of the Dominion Government, outlined plans which the government proposes to follow during the present year in opening up a new channel with a width of 300 feet and a low water depth of 20 feet, by improving what is known as the Northwest passage. Borings have been made, it is reported, which show that in dredging for the new channel no rock would be encountered. This condition is expected to greatly reduce the cost of the work, as well as to expedite the construction.

Efficiency in Municipal Engineering

Importance of intensive studies of the organization, cost of operation and efficiency of service in connection with civic undertakings—Give the engineer a freer hand

By R. O. Wynne-Roberts*

WHATEVER might have been the conditions in the past, there can scarcely be any doubt in the minds of public men to-day that the paramount need now is true economy. Engineering, rightly interpreted, consists in the economical utilization of forces and materials of nature for the attainment of specific results. To do more than is prudently necessary is not engineering. For example, a sewerage scheme will entail engineering ability whether the dimensions of the sewer are excessively large or legitimately adequate, but the engineer who had imbibed the spirit which should dominate his profession will aim at an economical solution of the problem which he has to study. Every expense should be justified by results, although it is not always possible to make them tangible at the time.

Suppose an electric lighting scheme is undertaken and the question arises as to whether the boiler and engine room should be built large enough for probable future requirements. To build a house sufficient for the present needs would cost, say, $50,000, but to provide for the next ten years would mean an additional expenditure of, say, $10,000. The engineer might find it easy to persuade the authority that the extra $10,000 should not be spent, although in five years' time it may cost $15,000 to furnish the same additional accommodation. It is reasonable to argue that the present ratepayers should be saddled only with the cost of the works which they actually want. This attitude is commendable so long as it is not pushed too far. The accommodation may be required sooner, and the works will have to be disturbed by building operations. The expenditure of $10,000 at present would at 5 per cent. compound interest amount to about $12,763 in five years' time, whereas the cost of building at the end of that period would be, say, $15,000; consequently as a business proposition it would be more economical to build now and save $2,237.

A Burden on Posterity

On the other hand, there is a temptation to incur liabilities at present and spread the cost over a long period—sometimes longer than the lifetime of the plant. This of course imposes a burden on posterity in the acceptance of which they have had no voice, and, furthermore, they must in some instances continue to pay for some plant or work which has become worn out, obsolete, or is in some other manner of no value to them. Efficiency and equity in such cases are matters of great importance to the civic financiers, as the load should be borne by those who enjoy the service.

The businesses of street pavement construction and maintenance are of great importance, because the quality of a civic administration may in a measure be judged by the condition of the streets and lanes. An average householder desires to maintain a presentable front-walk and doorstep, although the back yard may be somewhat neglected. In a like manner the city authorities generally like to have the streets appear good—sometimes even at the partial abandonment of other civic essentials. The subject of pavements would be sufficient for a series of articles, because efficiency depends upon the selection of the paving materials, the nature of the foundation, traffic, gradient, foothold, durability, facility of repairs, etc. But in general the pavement work should be of the higher quality suitable for specific conditions. Owing to the lack of judgment on the part of some authorities, and to the persuasive ability of agents in inducing the authorities to adopt some form of pavement, the choice of materials has not always been fortunate, and, as a result, the efficiency of the administration has been impugned.

Persuasive Powers of Agents

In certain instances the persuasive powers of agents have more than counterbalanced the advice of the engineers. The selection of the paving materials for different streets should ordinarily depend upon the cost of construction, life, interest and repayment of loan, the cost of repairs and cleansing. The character of the street demands some consideration, for while a high-class sett pavement may have the lowest annual cost, it would be unsuitable for a high-class business quarter or a residential district. Wood pavements have many virtues when the timber is thoroughly creosoted, but, unfortunately, efficiency in this respect is not the rule, which is greatly to be regretted, because Canada is so bountifully supplied with lumber that it would seem to be the natural paving material, whereas at present the bulk of the bituminous compounds used for paving work are imported. When timber is properly selected, efficiently pickled and carefully laid, it makes a good pavement of great durability.

Efficiency does not particularly appertain to new works; it may have a pronounced effect on the rates when considered in its connection with ordinary daily routine work. The average ratepayer is willing to see new works carried on, as it connotes progress and development; but when the time comes for the account to be paid in the form of demand notes for rates and taxes he then looks around for opportunities to economize, and perchance he may discover a place for the pruning knife. After a long personal experience in municipal administration in various capacities, the writer can assert that economy effected by the electoral pruning shears is rarely the most advisable. This does not mean that retrenchment should not be made, but that which may appeal to the public is not necessarily true economy. The search for economy should be made in all directions, so as to get as near one hundred cents' worth of service for a dollar as is possible, run the civic machinery at the lowest practicable cost, and at the same time assure that efficiency is not sacrificed. No municipal business can be operated like a dry goods store, because in the latter case the concern is managed by one mastermind, but in the former, since municipal matters are managed on the democratic principle, there are as many minds as there are ratepayers. But municipal business, notwithstanding this difficulty, can be carried on efficiently if the chief officials are given a free hand, and money can thereby be saved in many ways. Efficiency will

*Consulting Engineer, Toronto.

be secured provided the engineer is always allowed to think out carefully his plan of operation, and—what is still more important—that he is permitted to carry out his ideas without interference. If he succeeds, then he should receive public commendation; if he fails, then there is room for another engineer in his place. But failure will occur in very few instances under such circumstances. The writer on several occasions has been given a free hand to carry out work and, having the confidence of his Council and carrying great responsibilities imposed in this manner, he devoted every effort to retain such confidence, and succeeded, receiving public votes of thanks and something tangible for his service. Furthermore, efficiency was established and appreciable economics were effected. This statement is not put forward as a symptom of egotism, but as an argument for greater confidence in the engineer and the beneficial results which would accrue therefrom.

Ways of Economizing

There are different channels by which economics may be effected. One of them is through the store department. A city needs a large variety of stores, but it may not be in a position to employ a purchasing agent. It can, however, always keep a store and a store-keeper. Stores should be standardized, and a schedule should be prepared giving particulars of the requirements of each kind. Much might be said about standardizing stores, and the advantages of such an arrangement, but it may be stated that very tangible savings have been effected in this manner. One society in Canada has found it possible to save a large percentage on their printing account by changing their methods of placing orders. It is surprising what quantity of stores are required by an average city, and what they cost in the aggregate. It is by virtue of the stores department instituted by Baron Shaughnessy and copied by some American cities that the Canadian Pacific Railway Company are able to keep the annual expenditure of money on materials under effective control. It was pointed out at a recent meeting of the Toronto branch of the Canadian Society of Civil Engineers that Canadian bags of cement ordinarily weighed 87 pounds and American bags 94 pounds. As one cubic foot of cement is usually assumed to weigh from 94 to 100 pounds, and constitutes the basis of concrete mixtures, it is easily seen that if Canadian bags are used then from 7 to 13 pounds of cement (according to the standard adopted) are saved by the contractors. It is important that the stores should be carefully organized and operated, for a badly managed store department might easily nullify efforts to economize.

Efficiency in Operation of Plants

Efficiency in the operation of pumping and lighting plants is an important matter. Most operating engineers contend that they run their plant at least as economically as others do. Such a claim, however, is not very great when the details of the operating costs of different installations are analysed. The writer not long since had occasion to examine the returns from a number of electric lighting plants and it was surprising to note the great difference in the quantity of coal consumed per kilowatt of electricity sold. There are, of course, many conditions which contribute to such varied results, over which the engineer may have but little control. In one instance it was ascertained that the boiler settings were defective; in another, local inferior coal was used under unfavorable conditions. Notwithstanding these facts, it is essential that all points should be thoroughly investigated and properly adjusted if the rate-payers are to receive value for their money. Oil engines are popular for operating water pumps. It frequently occurs that the quantity of oil consumed per million foot-gallons is excessive. Take a case where one million gallons are raised daily to a total height of 200 feet, which is equivalent to 200 million foot-gallons per day, or 73,000 million foot-gallons per annum. The pumps are operated, say, 15 hours per day, or 5,475 hours per annum. The efficiency of the engine will be about 85 per cent., and of a turbine pump about 75 per cent., so the combined efficiency equals 63.75 per cent. The brake horse power will be

$$\frac{200{,}000{,}000 \times 10}{15 \times 60 \times 33{,}000 \times 0.75} = 90 \text{ B. h. p.}$$

The oil consumption is generally guaranteed at two-thirds of a pint per brake horse power hour, and therefore the quantity per year will be

$$\frac{\overset{\text{B.h.p.}}{90} \times \overset{\text{Pints}}{.66} \times \overset{\text{Hours}}{5475}}{8 \text{ pints}} = 41{,}060 \text{ gallons.}$$

But suppose the oil consumption was actually three-quarters of a pint, then the annual quantity used would be

$$\frac{90 \times 0.75 \times 5475}{8} = 46{,}660 \text{ gallons.}$$

an excess of 5,600 gallons, which represents a good sum.

Examine Machinery Periodically

There are many instances where the oil consumption is one pint and over per brake horse power hour. While it would appear that the oil used would be excessive, it may be taken as an indication that in other respects the efficiency was low. It is very desirable that engines should be indicated at frequent intervals and the cylinders and pistons thoroughly overhauled. Pumps should also be periodically examined and maintained in good condition.

Again, the slip in many pumping plants is high. The average slippage of all pumps in service in Chicago in 1911 was estimated at 15 per cent., while in other cities it is much higher. Slippage should not exceed, say, 5 per cent. before steps are taken to rectify the defects. It is palpable that the rate-payers lose heavily by allowing pumps to simply churn ten per cent. or more of the water. Slippage in meters is another serious item of loss, because if the slip is ten per cent. or more, as occurs in certain cities, then the revenue in those cases is that much less than it ought to be.

Returning to the fuel consumption, it was found in one district where the coal was reasonably cheap that the cost of that fuel per million foot-gallons ranged from two to eight cents, while the total cost of pumping ran from 5 to 21.35 cents. Take another power cost; the electrical energy used in one place cost 1¾ cents per million foot-gallons, and in another it amounted to about 20 cents. It is scarcely necessary to state that there is room for greater efficiency in the latter instance.

The question of what power to employ depends upon a few considerations, such as the size of the plant, type of pump installed, period of pumping, cost of fuel or energy, quantity of water and the height to which it has to be raised, and so on.

As another line of investigation, the cost of street lighting might be considered. Almost all cities, especially in North America, are desirous of maintaining their "white ways"—namely, streets which are illuminated brilliantly and artistically because it is thought that they constitute an attraction and an advertisement. It is questionable whether the rate-payers receive an adequate return for such investment. Besides, efficient street lighting involves the question of how to obtain the most light for the least expenditure of money and how all parts of a city are to receive their due share of lighting. Cluster lights are popular and no doubt add to the appearance of an important street, but the cost of lighting by these means is high when considered from the viewpoint of expenditure per foot-candle per square yard of street surface lighted or per any other standard. It is of course reasonable to expect business houses to incur considerable expenditure of money on exterior and interior lighting so as to make their premises attractive—that is a legitimate investment, on which they expect ample returns; which may be another way of interpreting efficiency, and in the case of a city, efficiency from a monetary standpoint should also come first. This does not exclude the proposition of the brilliant lighting of certain streets, but it does impose a duty on the administration of getting that standard of illumination at the most economical cost. This subject has occupied the minds of eminent authorities at Philadelphia, London, Chicago, Calcutta, etc.

Refuse Collection

Refuse collection and disposal is another line of study worthy of close examination. The writer is fully aware of the different conditions in cities, such as compactness of the areas served, distance of haulage, weight of loads, composition of the refuse, whether garbage, ashes and rubbish are separated, and if street cleaning is attended to by the same team.

An analysis of the statistics which are available reveals a great difference in the cost; garbage collection costs from 6 to 27 cents per capita per annum, Winnipeg occupying an average position on the list. Ashes collection cost from 4 cents at Winnipeg to 73 cents at Boston per capita per annum. The problem in this case consists in the arrangement of the routes so that the teams and men are efficiently employed

Allow the Engineer a Free Hand

Enough has been stated to show the importance of intensive studies of the organization, the cost of operations, and the efficiency of service, in connection with civic undertakings. Thrift is inculcated by our statesmen and advocated by all, but it requires a close investigation into the administration of various departments to obtain the maximum of efficiency at the minimum of expenditure.

Inasmuch as the functional importance of efficiency is as a rule a part of the engineer's training, it is manifest that it would be of advantage all round if engineers were allowed greater freedom in the management of the affairs of their municipalities. It would be invidious to refer to the excellent work done in this direction by engineers, but any one who desires information on the point can easily obtain it by studying the engineering journals. The fact that not much is heard of the achievements of engineers in this connection is probably due to their professional attitude. If they were gifted (?) with some of the attributes of politicians we should hear more of their work.

Petitcodiac Bridge, Moncton, N. B.

New steel structure to replace old wooden one—Specially designed to withstand destructive effects of tides and ice floes—Substructure will cost $200,000

By H. Bruce Jefferson

On June 30th, the Provincial Government of New Brunswick let to Messrs. Engineers and Contractors, Limited, Nova Scotia, a contract for the substructure of a new highway bridge across the Petitcodiac River at Moncton, N.B. The present bridge now in use at this site is a wooden Bhurr arch-truss, built in 1871-72. It replaced a former wooden bridge which had been completed in 1867, after being four years under construction, and which was carried out two years later by the Saxby Gale. Several spans of the present bridge were also carried out by a heavy gale in the nineties. The foundations of both these previous bridges were round timber cribwork piers, filled with rubble stone.

The provincial engineer, Mr. A. R. Wetmore, in designing the new structure, determined to make it absolutely permanent, and consequently found it necessary to secure a solid rock foundation for the mid-river piers. These piers were especially designed by the provincial engineer to minimize, so far as possible, the destructive effect upon the substructure by the heavy ice floes and bergs during the winter months, which are moved about with great violence by the strong tides and currents. These tides and currents present some of the principal difficulties in connection with the present work. The rise and fall of the water in the river is about twenty feet at neap tides and thirty feet at spring tides, and on the in-

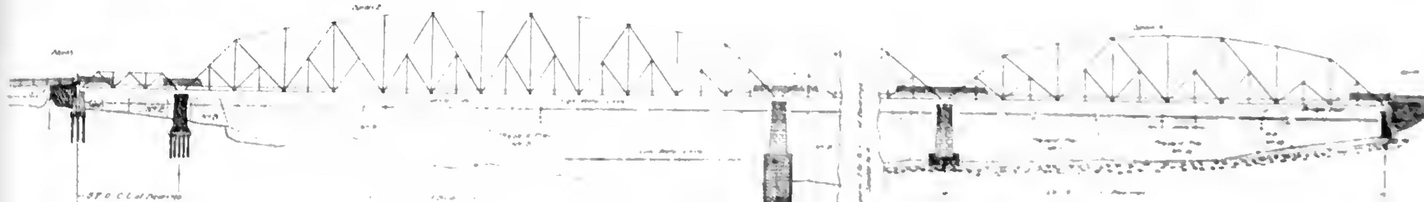


Fig. 1.—Part of side elevation Moncton Bridge showing end span—3 centre spans similar to span A not shown. Total length of bridge 1787 ft. Note relative size of present and new piers.

Fig. 2.—Pier B and north abutment.

coming tide, occurs within a space of about three hours. The tide flows with a velocity of about ten knots per hour, both up and down stream. Another circumstance which adds to the difficulties, from an engineering standpoint, is the regular appearance, twice every twenty-four hours, of the phenomenon known as the "Bore," a species of tidal wave which presents a solid wall of water four to six feet high. This heavy tidal action results in further serious difficulties owing to the fact that the water carries in suspension a large amount of mud which settles thickly upon the work at every low tide.

The accompanying illustrations show the general nature of the ground and the extent of the work required. Pier B (Fig. 2) is situated on the north bank of the river on the Westmorland County shore. The ground was excavated to a depth of about 12 feet, after which sheet-piling was placed and the remaining excavation cleared by means of pumps. It was then piled and capped with a concrete footing course to elevation 58. From elevation 58 to elevation 76, the bridge seat, the pier is of granite with concrete hearting. A similar method of construction was followed with the north abutment (Fig. 2), with the exception that the latter structure is built entirely of concrete. For the south abutment, which has been completed, an excavation was made to solid rock, with sheet piling and pumps, and a footing course of concrete employed as in the case of Pier B, granite being used from elevation 60 to elevation 76. The foundation for Pier No. 4 (Fig. 3), was secured upon solid rock, and a birch grillage laid to elevation 44. From elevation 44 to the bridge seat, 76, the pier is granite with a concrete hearting.

An examination conducted by the contractors, with

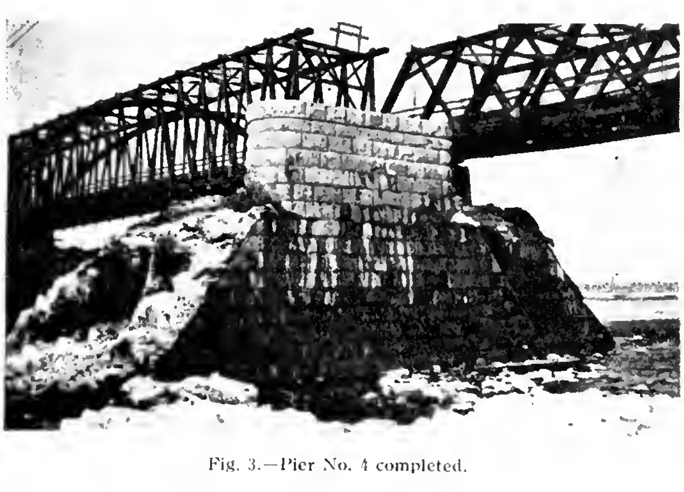


Fig. 3.—Pier No. 4 completed.

the aid of divers and a set of systematic soundings, revealed the situation, at the site of Pier No. 3, to be somewhat different from what was expected as the result of earlier surveys. It had been the original intention to place this pier by the use of the compressed air method, referred to later in the case of Piers Nos. 1 and 2. Through this examination, however, it was discovered that the rock ledge at this point was very uneven and in one place, about the centre of the pier, came to within a few feet of the low water mark. As a result of this discovery, it was decided to make an effort to place the foundation with an open timber caisson, fitted to the clean rock bottom. The contractors built this caisson on the Moncton side of the river, and around it constructed an outer casing allowing a space between, two and a half feet wide, for a puddle chamber. This caisson was launched (Fig. 4), taken across the river, placed in position and ballasted with iron rails to hold it to the bottom. The puddle, consisting of horse manure, clay and other similar material, was then placed in the chamber, and to prevent washing by the out-going and in-coming tides, the top was covered with bags filled with gravel. Pumps were then put to work, and one section was

Fig. 4.—Launching caisson for pier No. 3.

dried and the concrete placed. It was, however, some five or six weeks after the caisson was placed in position before the foundation was finally completed, owing to the fact that, for some unknown reason, the bar below the site of the bridge "made up" and held a greater depth of water than usual at low tide by about three feet. This resulted in such an increase of pressure that, after pumping down a short distance, "blows" repeatedly occurred, letting the water in, and it was only with the greatest difficulty that the foundation was finally secured. It was only possible to work about four hours each tide, which, of course, added to the general difficulty of the situation.

The construction of Piers Nos. 1 and 2 will not be undertaken until the spring of 1916. Recent borings show that a solid rock foundation can be secured for Pier No. 1 at a depth of eighty feet from the bridge seat, or forty feet below low water level. In the case of Pier No. 2, it is expected that the foundation will be secured about ten feet nearer the bridge seat. The contractors propose to secure these foundations by the compressed air method, working only at low tide, thus reducing, as far as possible, the enormous risk of carrying on work of this nature in such swiftly flowing water.

The contract was let by the Provincial Government on June 30th, 1915, and the contractors immediately prepared the ground for the erection of their extensive plant. To facilitate the work, a spur railway line was built from the Intercolonial Railway yards to the northern end of the bridge, a distance of about 2,000 feet, low ground near the yard being approached by a trestle 300 feet in length. At the bridge end another wooden trestle was built upon which cars providing gravel for the company's operations are run and unloaded. All material is conveyed from the north shore to the various structures by a steel cable-way, of Flory design, which consists of a steel cable one and three-quarter inches in diameter, suspended between two towers 1,591 feet apart; the one upon the north bank being ninety feet and the one upon the south bank eighty feet in height. Gravel is loaded from storage into small cars and hauled to the concrete mixers. The cement shed is placed close to gravel storage. A siding has also been built to facilitate the handling of granite, which is unloaded from the cars, upon which it is shipped, by a special derrick car. This car is also used for loading and unloading other materials upon small cars which are run upon a track built, for the purpose, under the cable-way where the material is picked up in slings and carried to the various structures.

The present steam plant, which runs all machinery, excepting steam hoists located near the different piers, for laying granite, other steam hoists, derrick cars and lighters, consists of two locomotive boilers of about 80 h.p., which will be supplemented by the addition of more boilers of about 200 h.p., when the air-compressors are installed. The air-compressors, which are of the Ingersoll-Rand straight-line type, will have a capacity of about 2,350 cubic feet per minute.

E. M. Archibald, of the contracting firm, is the engineer in charge of the work, which is expected to be completed by the first of August, 1916. The contract price for the sub-structure work is $197,000.

Royal Connaught Hotel, Hamilton

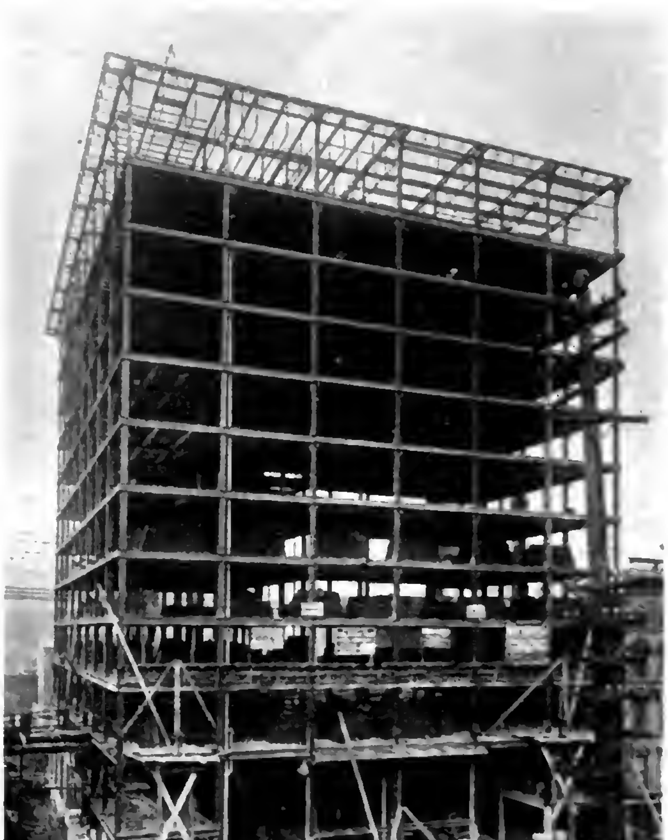
THE Royal Connaught Hotel, now being erected on King Street, Hamilton, Ont., for the Hamilton Hotel Company, Limited, is nearing completion, and will, when completed, be leased and operated by the United Hotels Company.

The building is in two sections; the main building and the annex. The main building consisting of the basement and twelve stories is a steel skeleton supported on reinforced concrete spread footings, with the outside walls or curtain walls built of hollow interlocking tile faced with Bedford limestone up to the second floor level, tapestry brick from the second to the tenth floor, and architectural terra cotta from the tenth floor to the top of the coping on the north and east elevations and with yellow Kittaning brick on the south elevation and in the light court. There is an overhanging terra cotta cornice on the north and east sides, a cast iron marquise over the main entrance, and a Bedford limestone port cochere over the ladies' entrance in the private driveway on the east side.

The floor slabs are four inch cinder concrete, reinforced with triangular mesh wire, designed to carry one hundred and fifty pounds per square foot on the first floor and seventy-five pounds per square foot on all other floors. The roof is a three inch slab to carry fifty pounds per square foot. The floors of the laundry, the public alley over the basement and the roof of the coal room are built of twelve inch hollow tile arches. All ceilings are metal lath except under the hollow tile arches. The partitions are built of three inch and four inch gypsum blocks except around the elevator shafts, where six inch terra cotta blocks are used. All the elevator shafts and stair wells are isolated from the rest of the building by partitions, and the openings in the partitions are protected by fire doors. The outside window frames and sash, in the annex and opening onto the light court of the main building, are metal and glazed with polished plate wire glass. On the east and north elevations the windows are of wood glazed with plain plate. In the upper stories, on the east and north elevation the top sash carry polished plate wire glass.

In the servants' and service portion of the building all the doors and wood trim are pine. In the guest rooms all of the doors and wood trim are birch with mahogany finish except the bath room and closet trim which is pine enameled white. All bath rooms and public toilet rooms have ceramic tile floors and base with cove. The bath room fixtures throughout the building are porcelain.

The main lobby is finished in Mycenian marble wainscot and real marble floor and base. The columns are Mycenian marble with plaster caps. The



Steel frame work erection, Royal Connaught Hotel.

ceiling of the lobby is at the same height as the mezzanine ceiling and deep ornamental plaster beams extend across the ceiling and above the mezzanine gallery. Around the edge of the mezzanine gallery opening onto the lobby below is a wood balustrade, with a wide railing on top. The doors in the lobby are mahogany and the trim is pine to be decorated.

The main dining room has marble floor and base and panelled pine wainscot nine feet high. The ceiling is high with heavy girders covered with ornamental plaster. All of the wood trim is pine for decorating.

All of the wood trim in the restaurant and the bar and grill room is of quartered oak. The floors are marble with a marble base. There is a paneled wainscot in each room and in the restaurant there are four columns. The ceilings are beamed with ornamental plaster.

On the mezzanine gallery and in the large banquet hall on the mezzanine floor the wood trim is pine for decorative purposes. The same applies to the two private dining rooms on this floor. There are eight large wood columns in the banquet hall set close to the wall and tight against wood pilasters of the same design as the columns. The ceiling here is vaulted in five sections separated by heavy plastered beams.

The service equipment includes, besides a complete kitchen layout, a laundry, a refrigerating plant and an auxiliary heating and power plant, including vacuum cleaning apparatus. There are two passenger elevators in the main building and two combined freight and service elevators, one in the main building and one in the annex. The electric service is brought in from outside the building through a switch board located in the basement. The direct current for the elevators is obtained from motor generator sets installed in the basement. There is a private branch telephone exchange at the office in the lobby, connected to each room and to all service departments. There are also six public telephone booths. Telegraph service is available in the lobby. Thorougl ventilation is assured by the installation of a complete system of fans, ducts and registers.

Certain of the difficulties met with in bringing the foundations to grade are here described:

It was necessary to underpin the foundations of the adjoining buildings along the entire west side of our excavation, the depth of the underpinning varying from ten to fifteen feet. On account of the poor condition of the old footings, the work had to be done in sections, filling in alternate spaces after the first piers were carrying their load. On part of the work, concrete was used for the underpinning piers where there was sufficient time to allow proper setting. On the other parts stone piers were built so that the load could be applied as soon as the piers were finished. In one section the underpinning had to be extended several feet deeper because of the change in plans which lowered the column footings at this point. The work was accomplished without the slightest accident to life or property and there has been no settlement of the footings since the underpinning was completed.

Borings were made which showed sand for about 10 feet, then 2 feet of strongly cemented gravel followed by a thick layer of running sand. Below the running sand stiff blue clay was encountered which continued down to the rock. The flow of water and running sand just below the cemented gravel called for heavy sheet piling and constant pumping when building the deeper footings.

Great care was necessary in building the outside basement walls to keep them straight and smooth. All of the outside columns are supported on grillage beams embedded in the concrete walls. This condition necessitated three pourings to reach the top of the wall and each time the forms had to be relined and

Royal Connaught Hotel, Hamilton.

the last section of concrete had to be thoroughly cleaned and coated with cement grout. All footings were poured in freezing weather. Before placing the concrete the bottom of the hole was thoroughly thawed out with steam. All concrete materials were heated and the concrete was placed hot. The completed footings were covered with straw, or in extreme cases were kept heated by steam under canvas. Records have been kept during the construction of the superstructure and at no time has there been any sign of settlement.

The concrete for all of the foundations was mixed in two three quarter yard mixers. It was placed from buggies, the length of wheel averaging about sixty feet.

The building was designed by Esenwein & Johnson, architects, Buffalo, N. Y., with Mr. A. W. Peene as the local associate architect. Stone and Webster Construction Company of Boston, Mass., are the gen-

(Continued on page 135)

Refined Asphalt Roads—A discussion of the Merits of Various Materials Used

By Leroy M. Law*

The subject "The Merits of Refined Asphalt Roads" would have scarce been a welcomed assignment five years ago, and in fact, any discussion along such lines would, of necessity, have had to be of prospective nature and of little promise at that, for most service experiences had proven failures, and an inadequate chemistry offered little ground for optimistic productions from the laboratory standpoint. Moreover, prospects, predictions and even promises do not find a very cordial reception in asphalt paving and road building, for municipalities, engineers, and contractors, by reason of their responsibility to others, wisely and justly demand more definite indications to success before changing a type of material or construction.

The "Merits of Refined Asphalt Roads" quite naturally resolves itself into the merits of the asphalts used in their make-up, for in the same type of construction, the mineral aggregates, their preparation, etc., will be practically the same for all asphalts.

The evolution of any product from early types to its more perfected form is dependent upon two factors, raw materials and the processes of manufacture, and in every progressive industry there is constant endeavor to improve both of them. Petroleum doubtless entered the paving industry as a "flux" or softening agency for the solid native bitumen which were too hard to be used for paving purposes in their natural condition. These fluxes were not straight mineral oils, but the residue of by-products of oil distillation. In those days the major products of all refineries were the burning oils, and later on gasoline and lubricants. The fluxes were, therefore, what remained in the still after these more valuable fractions had been taken out, and, under the name of "residuum" were generally considered as containing the lubricating oils, waxes, and pitch base. That they were actually refuse products, with little or no care in regard to their quality, is shown by the fact that the oils were frequently subjected to the so-called cracking processes for an increase over the normal yield of burning oils, but this caused a detriment and injury of the residuum. There are about six oil fluids in the United States, and though the oils in some of them vary from well to well, they are practically all distilled for the same major products. It was not surprising, therefore, that the resulting residues were variable in character, and often unsuited even for the purpose of fluxing the hard asphalts. Under such circumstances, petroleum asphalts originated.

Increasing Use of Native Bitumens

The increasing use of the more successful native bitumens early became the stimulus for the development of the residuals so that they might compete with the asphalts to which they heretofore had served only as adjuncts, and to do so, it was necessary that they be brought from their more or less fluid state to consistencies suitable for paving purposes. It was early found that distillation of the paraffin and semi-asphaltic petroleum beyond the "residuum" stage resulted in decomposition of the pitch or asphalt residues to such extent that their usefulness as paving materials could not be seriously considered, so other means were sought to achieve the desired end. For example, Dubbs found that the addition of sulphur to the residuum, maintained at elevated temperatures, resulted in a molecular condensation with liberation of sulphuretted hydrogen gas. The resulting artificial asphalts received the name of "Pittsburgh Flux."

Byerly, about the same time, found that by blowing air through the heated residuum the oxygen performed a similar function to the sulphur in the Pittsburgh flux and in 1893 took out a patent covering this air blowing process. This proved a most important step in the transition of petroleum asphalt for air blowing was cheaper than sulphur, and by regulating the duration of the "blow," asphalts of varying consistency could be produced. Materials produced by this blowing process have proven useful products, although at no time have they made any serious inroads on the native bitumens, for paving purposes. They were generally tough, rubberlike materials, low in susceptibility, but quite short in character, and have served chiefly as waterproofing, block-filler materials, rubber substitutes, and also to a very considerable extent as a constituent of the bituminous cements in asphalt paving blocks.

Compounding the Residues

Another step in the evolution of asphalts from petroleum was made by compounding with the distillation residues such quantities as hard bitumens, like gilsonite and grahamite so as to produce materials of paving consistencies. Many of these compounds contained as much oil as hard bitumen, and frequently the air-blowing process was used in their manufacture. Several rather successful asphalts of this constitution have appeared on the market in recent years. On account of the large percentage of the oil residuum required, however, the original element of uncertainty still prevails in regard to the finished product. This, together with the high price of gilsonite and grahamite and other factors, has doubtless served to greatly restrict the use of such preparations to-day.

This brings us up to about the year 1900, previous to which the oil asphalts were truly artificial materials, being prepared, at best, from oils of low asphaltic contents and their solidity and consistency were proportional to the artificial means employed in their manufacture. It was only to be expected that they should be called by such names as manufactured asphalts, oil asphalts ,and residual asphalts, even though such designations were not appropriate to the totally different types that followed. Asphalts from Texas and California petroleums next deserve attention, and it is interesting to note that, while they differed widely in characteristics, they are still in use to-day, though in modified form. The original Texas asphalts, on being blown, were low in susceptibility to temperature changes, but the low ductility retarded their adoption by many cities which were maintaining a minimum ductility requirement of 15 or 20 centimeters in their specifications. On the contrary, the California materials possessed practically unlimited ductility, and since they were obtained from full asphaltic base oils, it was

* Before the recent Worcester Convention

possible to omit the blowing process. This fact rendered their advent the turning point in the evolution of petroleum asphalts inasmuch as their preparation could be accomplished by a simple refinement direct to the desired consistency. There has, however, been a lack of uniformity in the crude supplies, and their high rates of susceptibility has been considered objectionable in many places. In spite of this, California materials have been quite successful, and are still in use.

Ideal Raw Material Found in Mexico

The ideal raw material for the production of petroleum asphalts, however, became available about five years ago with the entry of Mexican petroleum into the field of raw materials. These asphalts met successfully, recognized paving and road oil tests, and provided a plentiful and uniform supply of raw material. Mexican asphalts had appeared in the paving industry some years ago, but the early examples were but the more or less solidified effusions from the real supply, which lay thousands of feet below the surface. In 1910 the opening of several large wells on the east coast of Mexico opened a new epoch in the asphalt business. With large supply and reasonable rates of water transportation it was possible to place on the market excellent paving and road building materials at prices which have made possible our great highway developments of to-day.

Two types of Mexican petroleum constitute the general supply of crude material shipped; a heavy oil of 10 to 12 degs. Be. gravity carrying about 70 per cent. of asphalt and a lighter one of 18 to 21 degs. Be. gravity with an asphalt content of 55 to 60 per cent. These are obtained from wells of 3,000 to 5,000 feet depth, are collected in large storage tanks or sometimes in earthen ponds or lakes, and then pumped into specially constructed tank ships ranging from 30,000 to 60,000 barrels capacity, for transportation to the refineries. Both oils yield excellent paving materials. Their high asphalt contents and correspondingly low percentages of light oils allow prompt refinement with a minimum risk of injuring the asphalt residues which, in the handling of Mexican petroleums, are the major products of the refinery. With both types of crude it is commercially practicable to stop the refining or reduction process at any stage of consistency between the fluidity of the natural liquid and the solidity of hardest paving cement so as to give the engineer a material made by one simple process to the desired consistency. By such procedure, the natural fluxes are retained and subsequent artificial fluxing, with its attendant losses in time, is avoided.

Preference for Heavier Oils

For paving cements and road binders there is apparently a preference for products of the heavier oils, probably due to their greater density and lower paraffin content. The lighter oils, however, serve as the chief source for road surfacing materials. When simply freed from moisture and sediment, they serve as a cold surface dressing for macadam roads, the naturally occurring gasoline which they carry serving as a natural thinner to facilitate penetration into the road structure. Deprived of these lighter oils, they serve for the more permanent and so-called hot surface application. That the merits predicted for the materials by scientific tests have been verified is evidenced by their almost general use in many cities for sheet asphalt and asphaltic concrete. In many cities this pavement has successfully passed into its fourth year of service. In road construction and treatments, the uses of Mexican products have been even more general than in street pavements. Such recognition of asphalts from Mexican petroleum show that the early conceptions of "oil asphalts" are fast being obliterated; certainly they indicate that the character of the material itself is to be primarily considered rather than a mere classification in which the material may be placed.

With the entry of California materials, however, the possibility of simplifying the process of preparing petroleum asphalts was noted. This was largely due to the character of the oils themselves, which were fluid asphalts rather than mere oils. A high asphalt content with a corresponding reduction in the amount of burning oils resulted in a complete change of purpose and what had been known as the "residuum" or residue, now became the major product. This is the present practice in the refinement of the Mexican petroleum wherein every possible care is taken to conserve the asphalt constituents, leaving as the refuse or by-products the unnecessary volatile oils which are sold for fuel and gas making purposes.

Radical Change in Petroleum Refinement

This radical change in petroleum refinement has brought forth several new processes, among which may be mentioned those covered by the Dundas and the Trumbull patents. Both are of California origin, the former is little used, but the latter is in successful operation with both California and Mexican oils and is worthy of mention. Its operation depends on preheating the oil, pumping it to the top of heat-jacketed cylindrical towers and allowing it to flow down the inner surface in a thin sheet. Around a central vertical stand-pipe or "off-take" are openings, which allow vapors or light oils to pass off to the condensers. These openings are protected by conical or umbrella-like shields so that they will not become clogged by the asphalt as it passes to the bottom of the tower. The consistency of the asphalt depends on the temperature and the rate of pumping.

The most generally used process, however, is that of steam distillation, which removes the lighter oils from the associated materials at temperatures below their normal boiling points. The petroleum, after the removal of moisture by settling or some similar treatment, is charged into large stills of 1,000 to 1,200 barrels capacity. Heat is slowly applied and maintained throughout the run, but the distillation is actually accomplished by steam vapors. A current of live steam is passed into the heated oil and, issuing from a multitude of fine orifices along the still bottom, carries the light oils with it and the mixed vapors pass to the condensers. While these oils would require temperatures as high as 900 or 1,000 degs. F., for their actual distillation, this steaming process enables them to be removed at temperatures as low as 600 to 650 degs. F., but in proper regulated plants the asphalt in the still is never allowed to exceed such temperatures. Agitation due to the passage of the steam further assists in the work, by preventing any portion of the asphalt being long in contact with the still bottom where the heat is necessarily greatest. In the best regulated plants, recording pyrometers indicate the actual temperatures at all times and when careful tests show that the desired consistency has been reached the charge is allowed to cool and is then pumped into storage or drummed for shipment.

Opposition to New Materials

Following the path of its predecessors, it was, perhaps, to be expected that the higher types of petroleum asphalt as represented by the Mexican products, would encounter suspicion, doubt, and opposition on entering the field of competition. There had been, however, a parallel advance in the science of testing bituminous materials and it was anticipated that this would go far toward assuring reliability. It did to a very large extent; otherwise petroleum asphalts would not have attained their present high standing. Specifications were frequently deliberately closed to these materials, but thanks to the chemist and the engineer, these conditions have been largely eliminated, and the best type of petroleum asphalt are welcomed in open competition with all other good materials.

The Paris Building, Winnipeg, Man.

ON Winnipeg's principal thoroughfare, almost opposite the General Post Office on Portage Avenue, and just South of the junction of Portage Avenue and Main Street, there has been erected a magnificent $200,000 reinforced concrete building which has been named the "Paris Building."

Foundation Work

The general contractors, Carter-Halls-Aldinger, Ltd., have erected a five storey building 88 feet wide by 130 feet deep, but the building is designed for a future ten storey building with a 125 lb. live load on the ground and second floors and 65 lb. live load on the remaining floors.

The average size of column footings is 14 feet square with 30 inch columns in the basement. The system of reinforcing used by the C. A. P. Turner Company, the reinforced concrete engineers for the building, was a two-way beam and slab, the panels being 18 ft. x 22 ft. 6 in. In all there were 3,000 yards of reinforced concrete and 220 tons of reinforcing steel used in the skeleton frame of the building. A 1-2-4 mixture was used for the concrete, sufficient crushed granite being added to the gravel to bring the coarse aggregate up to the correct proportion. All the pits have a 7 in. concrete wall and 5 in. concrete bottoms.

Paris Building, Winnipeg—completed.

The exterior walls on the outside up to the grade line on all sides of the building are waterproofed with half inch coat of cement mortar and pudlo waterproofing compound.

The exterior finish of the building is terra cotta with an interior backing of good hard stock brick. This brick backing is laid simultaneously with and bonded into the terra cotta facing, with anchor rods, ties, etc., while the inner four inches of all exterior walls is laid with hollow brick. All interior walls and partitions are built of 4 inch hollow tile. The brickwork throughout the building is laid up in cement mortar compound as follows: One part best Portland Cement to three parts of clean sharp sand.

It is interesting to note that portions of walls, etc., bearing severe loads are built in extra hard brick, special care being taken that these portions of the work were well pointed, flushed up and grouted. Row lock arches are turned over all arches in brickwork. The walls facing the lane at rear are built of good hard stock brick, which were carefully selected for their evenness of color and face. The brickwork on the light court is of the best quality lime brick.

Electric Installation.

A complete system of wiring for electric lights, fan outlets, etc., has been installed. The wiring is for 110 volts alternating current on the three wire system.

The power wiring is for two passenger elevators with the exhaust fan on the roof at 550 volts direct current. The Star Electric Company, Winnipeg, installed the transformers and extended the mains in conduits to the switchboard which is located in the engine room in the basement. The general contractors, Carter-Halls-Aldinger, Ltd., Winnipeg, connected all the mains to the switchboard as well as extending the switchboard panels, which are of black slate 2 inches thick and 6 feet 6 inches high. The switchboard panels provide for the following fittings: Lighting panels, 110 volt alternating current, on which is mounted the following fuses, switches and meters:

One for each of the small stores facing Garry Street.

One for billiard room in basement.

One for each of the Portage Avenue stores and basements to same.

One for barber shop in basement.

One for all corridor, stairway, lavatories and boiler room, lights.

One for each of two show rooms on the second storey.

One for each office of three office floors above.

One for disc and fan motors in corner store and billiard room in basement.

The power panel, having 500 volt direct current, has the following fuses, switches and meters mounted thereon: One for each elevator motor and one for fan motor.

All fuses installed are of the renewable type, and each panel is completely wired on rear, devices and instruments connected to proper circuits, being ready for instantaneous operation.

The bus bars, which have been installed, are round copper, and are specified not to carry more than 800 Amp. per square inch.

The roof is covered by Barrett's tar and gravel roofing. All the elevator doors are of frame construction, excepting the door to the stair from the main entrance hall which is of hollow pressed steel, manufactured by McFarlane & Douglas, Ottawa. The main staircase from the basement to the roof has wrought iron ornamental railings with channel steel angles to receive the wood hand rail and rests on the moulded metal saddles cast to fit the concrete stair string.

The interior of all brick walls, brick and other partitions, the columns and the inside of all exterior walls, the inside of passenger elevator shaft, etc., throughout the building are plastered by the Western Plaster Company, of Winnipeg, with two coats of Manitoba hard wall plaster and one coat of white hard finish, all of which was supplied by the Manitoba Gypsum Co., Winnipeg.

The floors of the main entrance hall and vestibule are laid in marble square tiles 10 ft. by 10 ft. 1⅛ inches thick.

The walls of the main entrance vestibule and elevator wall up to the height of 4 ft. 6 in. have been laid up with 1 inch marble wainscot. The Missisquoi Marbles Ltd., Montreal, supplied the marble for this building.

The interior finish of the building is selected straight grained white oak, supplied by the G. W. Murray Company, Winnipeg.

The building is heated by a low pressure system of steam heating.

The structure was completed in quick time, the contract being let on April 15 last year to Carter-Halls-Aldinger, Ltd., and the tenants were occupying the new building within seven months of that date. Woodman & Carey were the architects.

Church of St. Francis of Assisi, Toronto

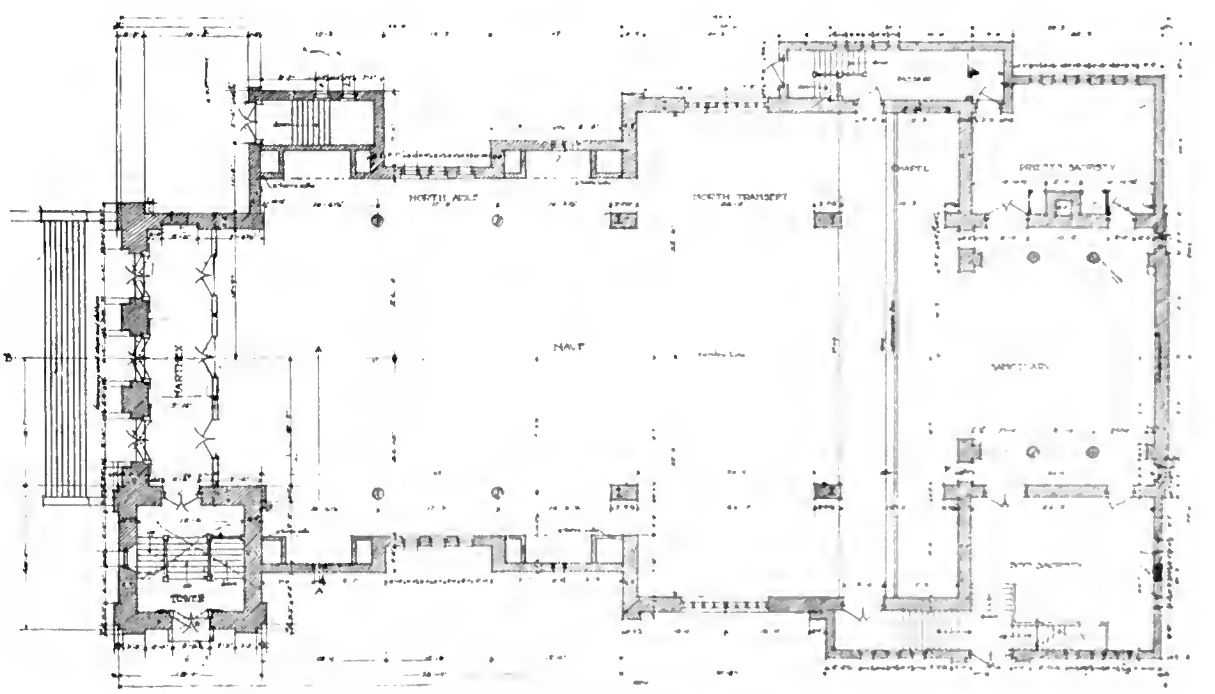
The new Church of St. Francis of Assisi, Grace Street, Toronto, was completed and dedicated in October, 1915. The building is in the Italian Gothic style, and is built chiefly of Credit Valley stone, with Indiana limestone dressings, except the pinnacles, niches, window tracery, etc., which are carried out in Roman stone. All interior columns, with their bases and caps, are built of Indiana limestone.

The main entrance, on the west, fronts on Grace Street, and utilizes three large double doors surmounted by ornamental, artistic windows in Roman stone relief. Access to the building may also be had through two entrances on the north, which are approached by a private walk, and by two more on the south, off Mansfield Avenue. Directly within the main entrance is a narthex 37 ft. 6 ins. by 9 ft. 10 ins., which is also

Church of St. Francis of Assisi, Grace St., Toronto.

Interior of St. Francis Church, Toronto. A. W. Holmes, Architect.

directly accessible through the tower from Mansfield Avenue. Three double swinging doors, corresponding respectively to the main entrance doors, open directly from the narthex, or vestibule, into the main body of the church. Directly over the narthex is the organ gallery. In the southwest corner is a tower 21 feet square, approximately 120 ft. high, with an open arch belfry, beautifully ornamented with Roman stone relief work. The nave in the main body of the church is 40 feet wide, and is flanked by narrow aisles, used

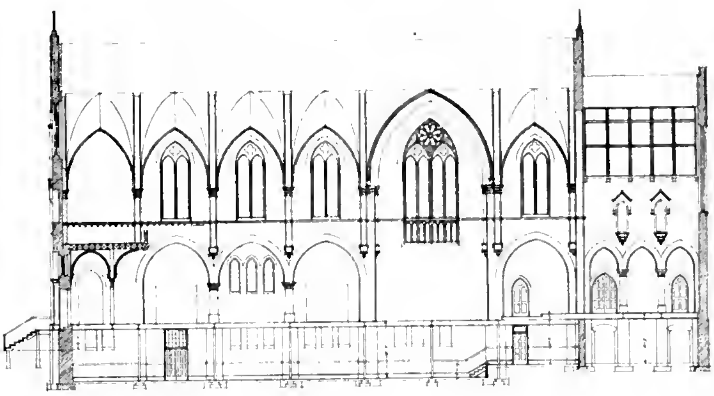


FIRST FLOOR PLAN
First floor plan, St. Francis of Assisi, Toronto.

as passages only, with a main aisle down the centre. On the north side of the sanctuary, which is situated at the east end of the church, is the priest's sacristy, with the boys' sacristy on the south side. The clerestory, which is supported by Indiana limestone columns connected by high arches, contains several large windows on all sides which efficiently light the body of the church. The lower set of panes of all windows on any one side of the church are connected with a link motion so that the windows may be opened by the operator from the floor below.

The roofs are supported by steel trusses, and the vaulted and groined ceilings are formed of steel framework with metal furring and lath. Ceilings and wall surfaces are finished in rough stucco with staff ribs, strings, corbels, and other ornamental works. The roof is slate covered. The basement auditorium, which is used as a parish hall, has a floor plan quite similar to the first floor, and will seat a similar number of people—namely, nine hundred. The east end of the basement is used for boiler and furnace rooms.

Furniture and all interior trim is quarter-cut oak. The church proper is lighted by two large 16-lamp



Sectional Elevation, St. Francis Church.

clusters over the main aisle, two 7-lamp clusters in the transepts, and single drops over the side aisles. Enclosed shades are used throughout. The total cost, including furniture, is nearly $120,000.

The building was designed and the erection superintended by A. W. Holmes, Architect, Toronto. The general contractor was Mr. R. Sheehy, of Peterborough; sub-contractors, heating and plumbing, P. J. Hayes; electric wiring, Bennett & Wright; fixtures, F. C. Henderson; mosaic work, the Italian Mosaic and Marble Company; furniture, the Globe Furniture Company and the Rosenblatt Art Works; steel sash and ventilators, A. B. Ormsby and the Luxfer Prism Co.

A postal-card poll of the Architectural League, Toronto, showed that three-fourths of the members were in favor of admitting women to their ranks. This sentiment will probably be incorporated into the constitution at the next annual meeting of the League. Architects, painters, and sculptors are eligible as members, and from the first, women have shown their work in the League's exhibitions.

Orders have been received in Montreal from Ottawa asking for the immediate recruiting of a detachment of fifty engineers. It is hoped that men who have had university training in applied science, engineering and similar courses will volunteer for the work, as their wider knowledge and training will make them valuable.

Quarantine Against Dry-Rot As Feasible As Against Small-Pox

According to the more recent authorities, decay in wood is a disease that may spread as smallpox spreads among the unvaccinated of the human race. No wood will decay unless the germs of decay are communicated to it from wood or other vegetable substance already infected. Rot is not inherent in wood or in anything else. It is communicated from subject to subject by the spread of the germs from one to another.

Decay in wood is caused by a plant growth that takes root among the fibers of the wood, and develops and spreads. The plant which does this is called a fungus. There are many species, some preferring one kind of wood, some another; some spread rapidly through the cells and fibers, producing rapid decay, others work slowly and do little harm. The germ which furnishes the means of spreading the rot from one piece of wood to another is called a spore. It is not exactly a seed, but it amounts to the same thing. When it falls on a piece of wood where the conditions of moisture and warmth are suitable, it grows like a seed, and sends roots into the wood and dissolves its substance, and that produces decay. The spores which do this are usually too small to be seen separately without a strong glass, but each microscopic speck may become a centre of infection. Spores develop and fly away through the air in countless millions, and fall everywhere in the vicinity, spreading rot over the surface of sound lumber if sufficient moisture is present.

Suggestions have been many times made that decaying lumber should not be shipped, because of the probability that it will communicate its own disease to sound lumber along its journey or at its destination. Without doubt such a thing often happens.

A little care in handling the material in the yard will prevent the incipient stages of decay, which, when transferred to buildings, may develop into full-fledged cases of dry-rot or decay.

The term "infected wood" may be defined to cover wood which contains the roots of any fungi which can continue to grow under the conditions in which the wood is to be used.

The sale or use of infected wood (that which contains fungi which can grow under the conditions of use) should be prohibited by law.

Our building codes require that steel girders and beams in the downtown office buildings be covered with concrete to prevent collapse in case of fire. Why should we not have a similar requirement that timbered structures be erected in such a way that dry-rot infection is impossible, the code to be so worded that ventilation, heat or preservative treatment be provided for under given conditions?

If the timber can be rapidly dried out and kept dry under the conditions of use, dry-rot cannot develop.

When a building is framed the ends of the girders and posts are usually fitted so tight together that drying is exceedingly slow, and it is frequently further retarded by the side plates of the girder supports. This is one of the principal points where dry-rot starts, because all the surfaces of contact have been or are subject to infection. However, the growth of dry-rot can be avoided by constructing these joints so that air can circulate around the heads of the sticks.

Where drying is likely to be slow because of poor ventilation or absence of heat, a wood preservative should be applied to the surfaces of contact.

Constructing Sewers in Winter Time

By Harrison P. Eddy*

UNDER many conditions that work which is most uniformly and continuously performed is most economically done. It follows logically, therefore, that where conditions are equally favorable at all seasons the greatest economy will result in the long run, if construction work is prosecuted at a uniform rate of speed throughout the year. Such a program would avoid waste due to great haste, which is always accompanied by inflated prices of labor and materials; would tend toward lower unit costs of labor and plant, which would then be continuously employed; and would render unnecessary a substantial portion of overhead costs due to idle capital and supervisory services while the work temporarily ceases.

Such is the ideal, a goal which can be kept in sight with advantage, but one scarcely to be attained in the cold climate of Canada and Northern United States. Nevertheless, much can be done to minimize the losses due to suspension of operations, if only resource and ingenuity are actively employed to overcome conflicting conditions.

Must Select the Work

Perhaps one of the most important steps is that of the selection of the work least unfavorably affected by low temperatures and snow. Upon sewerage and drainage works interior repairs are often made more advantageously in winter than in summer, because the air in the sewers is better, temperatures and humidity are lower, and infiltration and storm flows are at a minimum. Tunnelling may often be done advantageously in winter for here, too, atmospheric conditions are more favorable. These two classes of work can probably be done with as great, if not greater economy in winter than in summer.

Trench work is more difficult to do economically in cold weather, but even here, if selection can be exercised, the losses may be much reduced. For instance, deep ledge cuts may often be made with reasonable economy. The rock is no harder in winter than in summer. The same number and depth of holes must be drilled and the same quantity of dynamite must be used. Great care must be exercised to prevent the freezing of dynamite, but this can be done readily and does not entail material expense. On the other hand, a failure to exercise proper care may result in disastrous accidents and substantial resulting expenditures. Steam and air are slightly more expensive in winter, but with simple precautions this loss will be small.

Trenches in earth are likely to be rather costly—less so in dry sand and gravel than in wet silt, clay or hardpan. In travelled streets in New England the ground freezes to a depth of four to six feet. To loosen frozen ground with picks is an exceedingly expensive operation. It generally pays better to soften it by thawing the frost. This may be done by building fires in the street where the trench is to be excavated. One or two laborers can tend fires at night which will thaw sufficient ground for a trench one or two hundred feet long, but this method is better adapted to a depth of frost not exceeding two feet than to greater depths. This method may be subject to objection on the part of residents in the vicinity, on account of real or fancied danger of setting fire to their buildings.

Another method described by the author in "American Sewerage Practice," Volume II, p. 59, is that of steaming out the frost. When a steam boiler is available this method is quite economical and satisfactory. The ground along the location of the proposed trench is covered by wooden boxes open at the bottom. In the top of the box, which may be 12 to 15 ft. long, 10 inches high and the width of the trench, 2 in. holes are bored about 12 in. apart in rows about every 24 in. crosswise of the box. The boxes are banked around with soft earth, to prevent the escape of steam and warm air from within. One man can tend the fire under the boiler and steam out the frozen ground during the night. For steaming he uses a 3/4-in. gas pipe about 6 ft. long, provided with an iron cross-bar for a handle. To the end of this pipe the steam hose is attached, the other end being open. The operator places this pipe in a vertical position on the ground, passing it through one of the holes in the box. As the steam thaws the ground he gradually works the pipe down until he has penetrated the whole layer of frozen ground. He then withdraws the pipe, plugs the hole with a wooden plug and follows the same course in the next hole, and so on until he has thawed the entire length of ground required for the next day's trench. One man will usually be able to thaw out sufficient area of street for a trench four to six feet wide, 48 feet long, in one night, where the frost is 4 ft. deep.

It is usually practicable to place masonry in trenches in rather cold weather without serious extra cost, although materials should generally be heated. It is also desirable to cover the masonry and to provide some artificial heat to hasten the setting of the cement.

Trench Work Most Difficult

The backfilling of the trench and clearing up the street behind the finished sewer, are perhaps the most difficult and unsatisfactory parts of sewer construction in winter. Where practicable, the trench should be excavated and backfilled the same day, to prevent the freezing of the excavated material, especially if it is wet. It may cost more to re-excavate this material for backfilling than it did to excavate the trench in the first place. Filling a trench with frozen earth is to be avoided, if possible, because it is not possible to compact the fill so as to prevent future settlement.

In spite of the exercise of care in selecting the type of work to be done in winter, the use of labor-saving devices and the expeditious handling of the construction, winter work is almost certain to be less economical than that done under the more favorable weather conditions of the remainder of the year. However, under some conditions the additional expenditure may be warranted. Each case must be decided upon its own merits after a careful weighing of the advantages to be gained and the disadvantages certain to accompany winter work in cold climates.

On account of the present prosperous state of the steel trade, the United States Steel Corporation have decided to increase the wages of their unskilled employees by about ten per cent.

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* Of Metcalf & Eddy, Consulting Engineers, Boston, Mass., U. S. A.

Instructions on Making Concrete for Isolated Builder

The following brief instructions concerning the essentials of good concrete have been prepared by the Association of Portland Cement Manufacturers, having particularly in mind the needs of the farmer or similarly isolated individuals. Failures in concrete sometimes occur on account of lack of knowledge of the fundamental principles but it is believed that if these simple instructions are followed satisfactory results will be assured in all cases.

Aggregates to be Used in Concrete Construction

The sand, stone, and gravel usually found upon the farms of the United States are generally suitable for concrete construction, provided the following precautions are taken:

1. These aggregates must be free from vegetable matter, dirt, or other foreign substances.

2. When using bank-run gravel, the sand must be separated from the stone or pebbles by screening through a ¼-inch screen.

3. In small concrete structures, such as drain tile, fence posts, etc., the coarse aggregates (crushed rock or gravel) should range in size from ½ inch to ¼ inch. For larger work, such as silos, barn floors, ordinary foundations, etc., coarse aggregate should range from 1½ inches to ¼ inch.

4. The sand used should be coarse, hard, and clean, and graded from ¼ inch to fine, with the larger size predominating. Use great care in hand mixing. It is economical to buy a small machine mixed if the farmer intends to use concrete in large quantities.

QUANTITIES OF MATERIAL FOR ONE CUBIC YARD OF RAMMED CONCRETE

(Table from Taylor and Thompson, "Reinforced Concrete.")

Proportions by Parts			Percentage of Voids in Broken Stone or Gravel								
			50 Per Cent.*			45 Per Cent.†			40 Per Cent.‡		
Cement	Sand	Stone	Cement, Bbls.	Sand, Cu. yd.	Stone, Cu. yd.	Cement, Bbls.	Sand, Cu. yd.	Stone, Cu. yd.	Cement, Bbls.	Sand, Cu. yd.	Stone, Cu. yd.
1	..	2	3.57	..	1.06	3.37	..	1.00	3.20	..	0.95
1	..	3	..	..	..	2.60	..	1.16	2.45	..	1.09
1	2	3	1.81	0.54	0.80	1.74	0.52	0.77	1.67	0.50	0.74
1	2	4	1.58	0.47	0.94	1.51	0.45	0.89	1.44	0.43	0.85
1	2½	5	1.31	0.48	0.97	1.24	0.46	0.92	1.18	0.44	0.87

* Use 50 per cent. columns for broken stone screened to uniform size.

† Use 45 per cent. columns for average conditions and for broken stone with dust screened out.

‡ Use 40 per cent. columns for gravel or mixed stone and gravel.

Hand Mixing

Proper methods when concrete is mixed by hand, using a two-bag batch of 1:2:4 proportions, are as follows:

1. Size of measuring box for sand should be 2 feet square by 1 foot high, thus containing 4 cubic feet.

2. Load sand in wheelbarrows and wheel onto mixing board.

3. Fill sand-measuring box, lift box, and spread sand 4 inches thick over board.

4. Take two bags of cement, place contents as evenly as possible over sand.

5. Turn the sand and cement over until thoroughly mixed, so that no streaks of cement or sand appear.

6. Spread the mixture of sand and cement out carefully, place measuring box beside it, and fill twice with stone or gravel, then empty onto sand and cement mixture and mix thoroughly.

7. Add three-quarters of required amount of water slowly and evenly, at same time mixing the mass.

8. Continue mixing, adding balance of water when dry spots appear, until whole mass has been turned over three or four times. This should be sufficient. After final turning shovel into compact mass ready for wheeling to place.

Bank-run Gravel

Bank-run gravel is sometimes used as it comes from the bank. This is wrong, as no two places in a bank will have the same proportions of sand and pebbles. It is, therefore, always essential when using bank-run material to screen the sand from the gravel and remix in the proper proportions.

Colour Possibilities of Concrete

One of the strongest objections by architects to the employment of concrete for the external finish of enclosing walls is the unpleasing tint of the material as ordinarily prepared. A good deal of attention has been devoted to the surface treatment of concrete. White Portland cement has been used in many cases, but its cost is rather prohibitive for average work. Coloring matter, mixed with the sand before the addition of cement and water, is employed by various firms engaged in the production of concrete stone. The most satisfactory way, however, of obtaining a pleasing color and texture in concrete surfaces is to select aggregates of appropriate tint, and to clean away the cement so as to expose the stone. A surface so produced will not deteriorate and is exempt from the disadvantages attaching to rendered and to artificially colored surfaces. The film of cement coating the aggregate can be removed by brushing while still green, afterwards treating the work with a weak solution of hydrochloric acid, and washing away all traces of acid. Concrete surfaces may also be tooled in the same way as natural stone, the best results being obtained by mixing the concrete to be so worked with aggregate of small gauge. The material must be thoroughly hard before tooling, otherwise sharp edges and surfaces of fine texture cannot be obtained. By the judicious combination of tooled surfaces and details with surfaces obtained by the exposure of colored aggregates, the architect will be able to secure results of very pleasing character, and which possess the merit of exhibiting the materials actually employed throughout the construction.—Stone Trades Journal.

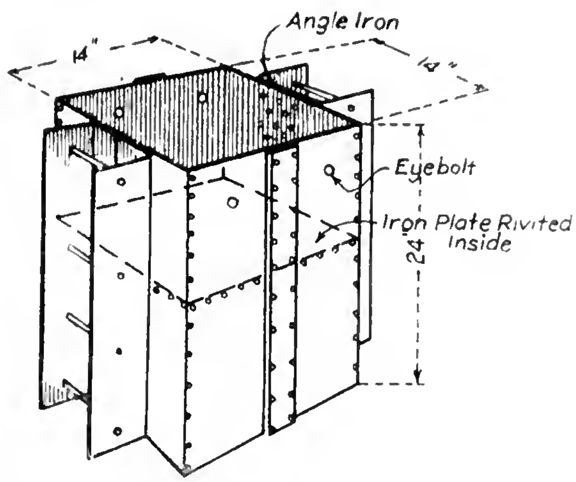
Properties of Manganese Steel

The chief characteristics of manganese steel were summarized in a paper read before the International Engineering Congress, as follows: this steel usually contains 10 to 13 per cent. of manganese and approximately 1 per cent. of carbon. It is practically nonmagnetic and has a peculiar hardness, to which it owes a remarkable resistance to abrasion. It is extremely difficult to machine. It has high strength and toughness, but relatively low elastic limit. With care it can be forged and rolled. It has found its principal application in castings for crushing and grinding machinery and railroad crossings.

Cap Used in Driving Concrete Piles

The accompanying illustration shows a steel driving cap of a type that has been successfully used in driving concrete piles. It is made up of ½-inch steel or iron plates braced with channels or angles on the sides as shown. A plate is riveted in the centre and holds the cushion in place on the pile. The cushion is six inches deep and is made of coils of manila rope. Often old fire hose or felt or belting is used for this purpose. Planks are sometimes placed under the cushion to help in distributing the blow over the top of the pile.

The cushion is placed in position and the iron cap is lowered over the pile to hold it in place. An oak follower is then placed on top of the plate inside the cap. If a steam hammer is used, it is fastened to the caps by means of a wire cable through the eye bolts on the side of the cap. The follower projects above



the top of the cap and is banded at each end to prevent splitting.

In the work where this cap was used, a large breakage was reported when a steam hammer was being used, so a heavy steam hammer was substituted and the ram was allowed to fall the length of the stroke, 3½ feet, without any steam pressure behind it. This method was very successful.

In recent pier work in San Francisco, however, concrete piles 106 feet long were driven with a very small percentage of breakage with a steam hammer.—Cement World.

House Plans at the Building Show

One of the features of the Complete Building Show at the Coliseum, Cleveland, will be in the house plans resulting from a competition for $500 in prizes, which has been offered for the best design for a house to cost $3,000. Special arrangements are being made to visualize the first prize plans in the exposition. The Cleveland Art Association will erect at the Complete Building Show a miniature model of the prize-winning plan and will surround this with the room arrangements in full scale, each room completely decorated and furnished.

The competition is under the direction of the Cleveland Chapter, American Institute of Architects, in co-operation with the Cleveland Art Association, the Cleveland Builders' Exchange and other civic organizations of the city.

Test of Hollow Building Tile

A very interesting test of hollow building tile has been made by the United States Bureau of Standards. A floor slab 6 feet wide and 30 feet long, continued over three piers 15 feet apart, was made of this class of material. This tile is of a special type for use in floor slabs, and is made so that the bottom surface is about 2 inches wider than the top. In laying the tile in the form of a slab, the pieces touch on the bottom, but are about 2 inches apart at the top. This space continues throughout the length of the slab, and is filled with a mortar of the composition of one part of cement and two of sand, in which are placed several reinforcing rods, bent up at the ends of the slab and continued through the concrete beam into the next adjacent slab.

In the present case the two slabs were allowed to age for one month. Tests were made of these, loaded uniformly with pig lead, numerous deflection readings being made as different loads were applied. One of the slabs was able to withstand a slightly greater load, 690 pounds per square foot. Failure occurred in the mortar beams, due largely to the inferior grade of reinforcing used. One of the concrete supporting piers also failed near its base. While the load carried was not up to the expectations of the manufacturers of the tile, yet it was considerably in excess of that demanded by most building laws.

Royal Connaught Hotel

(Continued from page 126)

eral contractors, with the following sub-contractors:

Black & Boyd Mfg. Co., New York, electric light fixtures; Canadian Ice Machine Co. Ltd., Toronto, refrigerating plant; Canadian Laundry Machinery Co. Ltd., Toronto, laundry machinery; L. K. Comstock & Co., Montreal, electric wiring; Duparquet, Huot & Moneuse Co., New York, kitchen equipment; Drake Avery Co. Ltd., Hamilton, plumbing and heating; Dennis Wire & Iron Works Co. Ltd., London, Ont., ornamental iron; Ebsary Fireproofing & Gypsum Block Co., New York, fireproof partitions; Federal Terra Cotta Co., New York, architectural terra cotta; Hamilton Bridge Wks. Co., Hamilton, steel frame; Hobbs Mfg. Co., Limited, Toronto, plate glass; The Canadian Jewett Refrigerator Co. Ltd., Bridgeburg, Ont., refrigerator boxes; Long Lumber Co., Hamilton, Ont., doors; Lautz-Dunham Co. Ltd., Toronto, marble and tile; A. B. Ormsby Co. Limited, Toronto, metal windows; Otis Fensom Elevator Co., Toronto, elevators; Ritchie Cut-stone Co., Hamilton, cut stone; Valley City Seating Co., Dundas, Ont., cabinet trim; White Fireproof Construction Co., New York, reinforced concrete floors; W. H. Yates, Jr., Hamilton, masonry.

Annual Road Builders' Convention

The thirteenth annual convention of the American Road Builders' Association has been changed a week from the original date, and is now scheduled for the week of February 28, the closing day being March 3. The meeting will be held in Pittsburgh and an interesting program is being worked out.

Roadmaking Equipment Catalogues

The Department of Highways, Ontario, will be pleased to receive current catalogues and literature from manufacturers of and dealers in roadmaking material and equipment. Geo. Hogarth, Chief Engineer of Highways, Parliament Bldgs.

Diesel Installation in Duncan, B. C.

Latest type of this machine operating continuously for many months—High efficiency at all loads—Low rotative speed

By W. Poole Dryer

Particular attention attaches to the new municipal electric power plant at Duncan. It marks a further advance in Diesel engine design and construction. The installation consists of two Morley-Guldner Improved Diesel engines, each of 100 h.p., direct connected to three-phase alternators. Since the plant started operation several months ago, it has carried the entire town load and is giving twenty-four hours' service. It is satisfactory to record that the engines have given continuous service without stoppage, showing that Diesel engine power plant is absolutely reliable and free from mechanical troubles. Engines made to these designs have been installed during the last few years in remote places all over the world; their reliable operation where skilled attention is not obtainable has justified the modifications made to older Diesel practice.

The true Diesel 4 cycle principle is retained. The elevation of efficiency and the elimination of troubles are obtained by boldly adopting low rotative speeds—none of these engines run at more than 212 r.p.m. This twofold result of low speeds is well worth the change, for nothing so retarded the general adoption of Diesels for years as the attempt to make the engines run at high speeds for which they are not inherently suited—most of the mechanical troubles were due solely to that cause. The low speeds slightly increase the size of the engine, but ensure great reliability in operation; lower fuel consumption is a necessary concomitant of low speed.

Valve Mechanism

A radical change is introduced into the valve operating mechanism, as will be observed on the accompanying illustration; the cam shaft is fixed low down on the frames, not as in the older Diesels up among the congestion of valve levers at the top of the cylinders. By lowering the cam shaft to this new position, the valves and levers are left very accessible and can easily be removed—a point all operators will appreciate; and the cam shaft itself is now in a very convenient position, being just at the hand of the operator standing on the floor. A further important innovation is that the cam shaft runs in an enclosed oil bath which ensures perfect lubrication and silent operation—the usual Diesel click of the cam shaft is absent. The vertical rods seen in the illustration are the valve connecting rods which are moved up and down by the cams at their lower ends.

Governing

A separate fuel oil pump is used for each cylinder, thereby ensuring an equal distribution of work between the cylinders. The speed of the engine is regulated and controlled by a spring loaded governor which proportions the amount of fuel oil used in each power stroke to the momentary load of the engine. This is effected by the governor automatically adjusting the opening of the fuel oil suction valve, holding it more or less open as the speed varies, and so allowing the excess oil to be pumped back into the suction pipe instead of being forced to the cylinder.

The governor itself is located on the top of the vertical shaft which drives the cam shaft, and it has a speed-adjusting device attached to it by means of which the speed of the engine can be altered while running.

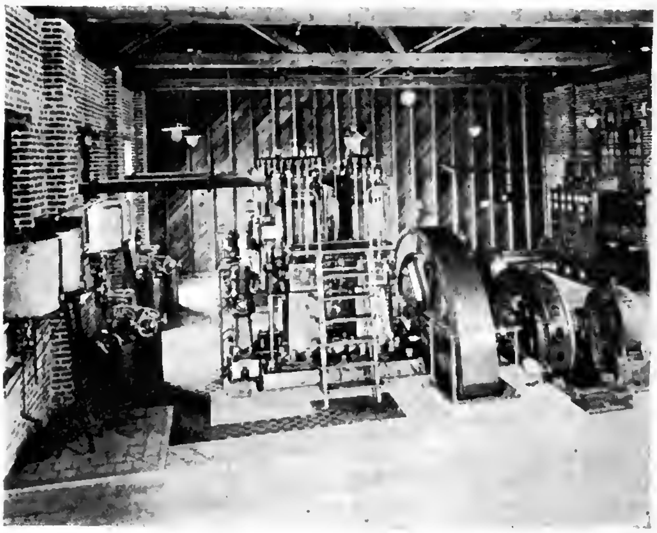
Forced lubrication is adopted, the oil going first to the piston, and then to the gudgeon pin.

Air Compressor

The air compressor is situated at the end of the crank shaft, and is direct driven by it. This position gives accessibility and allows the compressor to be designed according to the best practice. Flat disc valves are used, which, besides eliminating "sticking up" troubles, give a high volumetric efficiency resulting in a small power being required to drive the compressor. The air is compressed in two stages with inter-cooling, and is delivered to the running bottle, where it is throttled by hand at the outlet; this regulation of the blast determines the quantity of oil blown into the cylinders proportioning it to the load demand. In addition to the running bottle two very long starting bottles are attached to each engine; and the reserve capacity of these bottles is so large that the Duncan plant can be started up a dozen times without recharging them. No trouble need ever be feared from loss of pressure, nor need provision be made for independent means of recharging the bottles. As the engines never fail to start with the first blast from the bottles, the excessive reserve of starting power is merely a safeguard against inexpert handling.

General Operation

For the operation of the plant one man per shift suffices; and it will be of interest to mention that the operators in this plant were previously quite unacquainted with the running of Diesel engines. Yet so simple and reliable is the Diesel electric station now, that in its ten months of continuous operation no trouble or mishap has occurred in this plant. Overshading even the great saving of labor and maintenance is the economy of fuel costs compared with steam plants, the actual fuel cost in the Duncan plant being approximately one-third of a cent per kw. hour.



Interior Diesel power plant, Duncan, B.C.

It might be added that the successful operation of the Duncan installation is in no small way responsible to the enthusiastic interest taken in it by the City Engineer, Mr. M. Leighton Wade.

The Kaministiquia Power Company

Rapid development of Canadian Twin Cities Due Largely to Ample Supply of Dependable Power — Latest Installation Work at Kakabeka Falls

By P. R. Farrow*

The Canadian twin cities of Fort William and Port Arthur, at the head of Lake Superior, occupy a strategical position in the commerce of Canada. During the seasons of navigation west-bound merchandise is carried largely by boat, on account of the low freight rates, and there transferred to rail, or stored for delivery during the succeeding winter months. East-bound grain, forest and mineral raw products are also transferred here, forming return cargo. The great bulk of the coal for the Middle West is brought up by boat during the summer from Buffalo and Cleveland, and transferred or stored, at immense electrically-operated coal docks.

At Port Arthur and Fort William are situated some of the largest and most modern coal docks on the continent. Upwards of 3,000,000 tons of coal are shipped through this port every year. The transfer facilities to handle this traffic must necessarily be of the very best, and electric power has here proven itself a most dependable and efficient servant. All the coal docks, of which there are five, are operated by electric power.

Grain Facilities

In the transfer and storage of grain these ports excel all other ports in the world. The storage capacity of the port is now over 45,000,000 bushels, and is being increased yearly. During the fall rush, grain is delivered day after day into the elevators at the rate of 2,000,000 bushels per day. It is then graded and transferred to boats for delivery at Georgian Bay, Lake Erie and the St. Lawrence ports.

Here again electric power performs a most important service, on account of its adaptability, efficiency, reliability and convenience. As new storage units are added to the elevator, the simple electric motor readily adapts itself to suit any location and meet any service, and yet can be centralized and controlled from one point.

On account of the location of these twin cities as a bulk-breaking and storage point for raw and finished products, it was obvious that they were destined to become large manufacturing and milling centres. The cities are now served by three transcontinental roads, and have a population of about 45,000.

The one other element necessary to complete the chain of facilities was introduced in 1906, when the Kaministiquia Power Company began delivery of electric power from their hydro-electric development at Kakabeka Falls. After nine years of operation this company can point to a record which for continuous and uninterrupted service has probably not been excelled by any other plant in Canada. Trouble, inconvenience or delay from ice, backwater or water shortage, is unknown, and from all causes the aggregate interruptions to the system have not exceeded twenty minutes in any one year. During the past year this record has been reduced to less than four minutes and the company have further plans and improvements under consideration by which they hope to reduce their service interruptions to the vanishing point.

The details of the electric power plant are covered in considerable detail below. The plant is located at Kakabeka Falls—a beautiful falls with a sheer drop of 110 feet, located some twenty miles northwest from Fort William, on the line of the Canadian Northern Railway. The water is brought overland for a distance of one and one-quarter miles in reinforced concrete aqueducts, of which three are now completed. At the brow of the hill, just above the power house, the aqueducts empty into a regulating reservoir or forebay, in which are located the recently installed automatic controlling gates for each of four steel penstocks, through which the water is carried to the power house turbines. The turbines operate under a net head of 180 feet. The power is generated at 4000 volts, transmitted at 25,000 volts to Fort William and Port Arthur, and there distributed at 25,000 volts and 2,200 volts.

The original installation was commenced in 1905, and in the fall of 1906 the first two units of 4,400 kv.a. each were completed and placed in operation. In 1911 the business of the company had expanded at such a rate as to justify the installation of a third unit. In 1913, taking advantage of the temporary trade depression, with its resultant low costs for equipment and installation of plant, the company commenced the installation of a third concrete aqueduct, and a fourth unit of 9,375 kv.a. This was completed and placed in operation in the fall of 1914.

While there has been a temporary falling off in manufacturing in the twin cities, as elsewhere, this has been largely counterbalanced by the manufacture of war munitions, and by the abnormally heavy grain movement. The 1915 grain crop exceeded all anticipations, and has been phenomenal in the history of the country. Ordinarily the bulk of the grain rush is over in December. It is estimated that it will keep all available rolling stock busy all winter, and all the railroads and boats busy all next summer, to get the grain out of the country before the next grain crop comes in. The railroads are the greatest distributors of the wealth of the country we have. This great movement of grain cannot but have a very beneficial and sustaining effect on the trade of the country throughout the coming year.

Summary

The following data covers the additions to the plant of the Kaministiquia Power Company, Limited, at Kakabeka Falls, during the period between June, 1913, and September, 1914, which consist of a reinforced concrete aqueduct, one and one-quarter miles long between the intake and forebay reservoirs; the installation of steel butterfly gates as head gates of the penstocks, in the forebay; the erection of a steel penstock, 740 feet long, eleven feet diameter, between the forebay and the power house, with a concrete covering; extensions to workshops and valve house; erection of a special battery house near the forebay to control the steel gates therein; erection of a 12,500 h.p turbine and 4,000 volt generator; five step-up transformers, with necessary switching and indicating switchboard apparatus; two storage batteries with their switchboards; the installation of an improved lighting system in the power house and various incidental work in connection with the above.

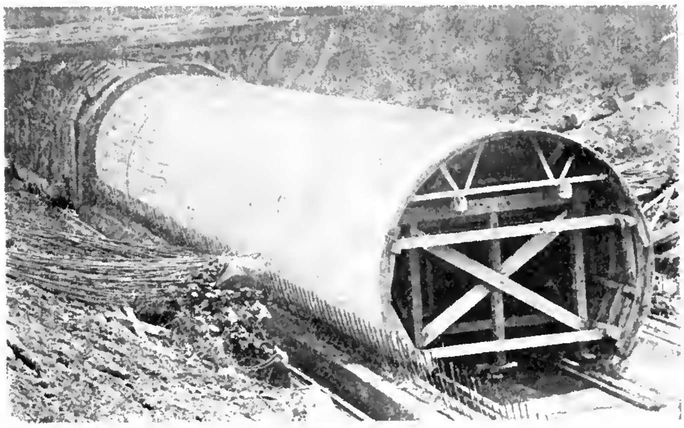
Aqueducts

The centres of the inside and outside of this pipe, which is an equivalent area to a 10-ft. diameter circle, are vertically offset one and one-half feet. The interior cross section of the pipe is that of a circle 10 ft. 6 in. diameter, with a segment cut from the bottom four feet from the centre, forming a flattened base. The bottom slab thus formed, is ten inches thick and is carried out until a line sloping at eight degrees with the vertical approaches eight inches minimum

* Power House Superintendent.

to the interior. At the top the concrete is six inches thick and an arc with radius 6 ft. 1 in. meets the sloping sides and completes the section of the pipe.

Grade and Ground.—The formation of the surface upon which the pipe lies is very varied over its length of 6,500 feet, running from solid rock near the intake, through clay, boulders, swamp, quicksand, hardpan and gravel with boulders, to the forebay. For the first 500 feet from the intake, the pipe practically follows the river bank and at two places the bank had to be filled in with rock and a concrete retaining wall built on the bank to form a support for the base, one of these fills was 30 feet, maximum depth. At the intake the pipe runs below the level of the river bed and a retaining wall, to deflect ice and otherwise protect the pipe, was built up from rock from the aqueduct base level. A drain was also built from the intake to a point in the river 450 feet below to obtain the proper fall and to drain all aqueducts when necessary, for inspection. For 2,000 feet the aqueduct runs level from the intake over a rock bed, it then dips gradually to 4.5 feet below grade through a rock fill overlying clay and boulders for 1,000 feet, then for 900 feet it rises to 3.5 feet above the preceding level, passing through an excavation of hardpan and gravel; for the next 500 feet the level falls again through a fill over a quicksand. This portion of the grade was sheet-piled by double 2-inch planking driven four feet outside the base of the pipe and provided with drainage to take off water, but so arranged as to prevent the sand working out from under the base of the pipe. The pipe then passes over gravel, which was levelled for 900 feet, and into a deep cut of gravel and boulders, varying from six to nine feet deep and fourteen feet wide, which runs practically level to the forebay.



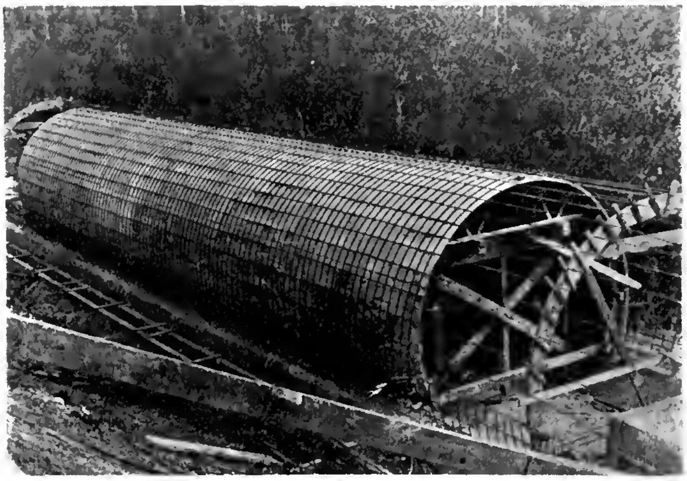
Inner form in place, outer form and pouring platform in background.

Concrete and Reinforcement.—The concrete aggregate consisted of one part of cement, two parts of washed sand, screened to pass through a ¼-in. sieve, and four parts of gravel screened between ¼-in. and 1-in. sieves. The cement, purchased on acceptance tests from the Canada Cement Company, was from one mill, and of a uniform quality, was required to pass the C. S. C. E. tests for Portland Cement, and to be of slow setting quality. The quantity of concrete used for the pipe amounted to 1.2 cu. yds. per lineal foot. The reinforcement was composed of one-half inch circular steel bars of standard specifications, spaced longitudinally from 12 in. to 15 in. apart and transversely from 5¼ in. to 6 in. apart, tied with No. 14 gauge annealed iron wire at all joints and lapped 12 ins. at ends of bars and firmly tied. No expansion joints were provided but it was hoped that sufficient hair cracks would develop to allow for contraction and prevent excessive leakage.

Forms and Centres.—The forms for moulding the pipe consisted of fifty-foot sections of steel framework, divided into three parts, running on wheels on special tracks along the pipe line, supporting a galvanized iron lined wood framework properly braced upon the steel frame, but collapsible by removing a few bolts. Over all was placed a wooden platform with central openings to allow the concrete to be deposited from carts directly into the form. The interior forms were wood, steel braced, and solid for the upper quarter section of the arc. To these were hinged side segments braced laterally when the forms were erected. The whole of the interior form was collapsible and was carried upon a track and a special carriage along the floor or bottom slab of the pipe, after it had been constructed. The forms for the bottom slab consisted merely of sides to support the concrete from the outside, lengthened to hold the transverse reinforcement in place, and a special interior form to bring the sides up 10 inches above the base before setting the upper forms.

Concrete Plant.—Two No. 2½ Smith concrete mixers, a 1/3 cu. yd. clam shell bucket, a two-stage, 25 h.p. centrifugal pump, one duplex pump, all electrically operated by three-phase, 550 volt alternating current, an electrically operated hoist, and a tower for washing and screening gravel and sand, formed the plant necessary to construct the aqueduct. A three-foot gauge railway, with eleven wood and steel contractors' dump cars was used to deliver material, and finally to cover the pipe, after completion, with three feet of earth covering as a protection from frost.

Method of Construction.—After grading and filling had been completed, in 1913, and allowed to settle all winter, the bottom slab, a simple slab 10 ins. thick, was laid after placing side forms. All reinforcement were bent at the works, from proper lengths of rod supplied, on a special bending machine. A centre form was placed and the sides brought up ten inches to form a support for the large forms of the superstructure. After the whole bottom slab had set for eighteen hours the forms were removed and the track laid for the upper forms, on the interior, directly upon the concrete slab and on the exterior upon a thin slab of concrete brought to the correct grade. The interior forms were then set for a distance of fifty feet, braced to the lower slab at the correct height and the longitudinal and transverse reinforcement applied and tied in place, with properly staggered and overlapped joints. The side and top form was then brought up, the sides cleaned and closed for concreting, set in place and braced on the lower section to prevent springing. Concrete was then placed on each side equally through small doors in the upper curve. When full to the level of the doors they were closed, and concrete poured from the top,



Transverse and Longitudinal reinforcing in concrete aqueduct—
Kaministiquia Power Co., Kakabeka Falls.

through a four-foot opening, until full. The top was then finished off over the open section by trowels. The whole operation of concreting took from 2½ to 3 hours for each 50-ft. section. The forms were ready for removal twenty-one hours after the concreting was finished. Three sections of fifty feet of forms were built, with an extra interior section enabling, even under the most difficult circumstances, one hundred lineal feet of pipe to be completed per working day, after all preliminary work had been completed. The pipe was finished by plastering all defective work and applying three coats of cement wash to the interior surface.

Vents and Drains.—14-in. drain valves were placed at each end of, and at two low points along the length of, the aqueduct, serving to empty the pipe, when closed off at each end, for inspection. Wooden stop logs form a barrier both at the intake and forebay ends when it is necessary to inspect the interior. Air vents are placed at three high points and serve to discharge accumulations of air carried by the moving water and to admit air freely when the water level falls. These consist of 8-in. diameter pipes screwed into cast nipples attached to the reinforcement. The whole is surrounded by a wooden framework to protect from injury and prevent early freezing in winter. Artificial heat is applied in winter to keep the pipes free of ice. The drain valves are protected by concrete walls with a wooden housing at the top, and are operated by long handles from the level of the earth covering on top of the pipe; sufficient room is provided at the bottom of the concrete pit to remove the valve for repairs when necessary.

Materials.—The gravel and sand for the concrete was obtained from pits on the company's property and separated and washed in one operation by dumping the excavated material into chutes, where water carried it over properly adjusted screens. From thence the gravel and sand was carried to bunkers and the water and waste material allowed to settle, the remanant being used for covering the completed pipe.

A special covering of three feet of earth was placed over the pipe as soon as completed, to protect the concrete while setting, from the sun, and to prevent frost in the winter

First completed section of aqueduct. Buggies used for conveying concrete from the mixers on pouring platform—Forebay in background.

from penetrating the pipe. The cover has been seeded to grass to hold snow in the winter. The necessary forms were built at the work, a sawmill with a circular saw, planer and band saw being provided to make the necessary material.

The reinforcement was provided in proper lengths by the mill, and bending machines in the field shaped all transverse bars.

Organization.—The whole work was in charge of Mr. Geo. Lewis, with an engineer for laying out the grades and levels, a general foreman, and a gang foreman on each section of the work; a timekeeper and storekeeper completed the staff. Inspection and testing was conducted by the engineer and writer, the company's superintendent.

Invert completed and track laid for inner forms. Outer forms being placed—Note reinforcing rods to join the invert to the superstructure.

(Continued in February 16 issue)

Personal

Mr. James McHaney has been appointed town engineer of Southampton, Ont.

Mr. Mark Workman has been chosen to succeed Mr. J. H. Plummer as president of the Dominion Steel Corporation. Mr. Plummer, whose health has been poor for some months, has retired to take an extended holiday abroad.

Mr. O'Hara, engineer of the Cloverdale municipality, B.C., has resigned to accept another appointment.

Mr. Herb L. White, formerly manager for The Superior Construction Company of Sudbury, Ont., and later of Hobon, Ont., has resigned to accept a position in Buffalo.

Mr. R. J. McMurray, one of the inspectors in the Toronto city architect's department, has enlisted in the Third Division Ammunition Column. Mr. McMurray has been with the department about a year and a half. He is the third member of this department to enlist for overseas service

Obituary

Thos. E. Baker, contractor, Prince Albert, Sask., died recently.

W. Ernest Barker, a well-known carpenter and builder of St. John, N.B., died on January 27.

Pte. Oliver Beech, formerly assistant to the city engineer of Macleod, Alta., died from wounds received in action recently. He was 28 years of age.

Mr. Chas. Bodley, Sr., a well-known resident of Mount Forest, Ont., died recently, in his 86th year. He was the designer and constructor of most of Mount Forest's old public and private buildings.

Mr. Egbert Fulljames, who with his brother carried on a contracting business in Cranbrook, B. C., for some years, died recently.

Senator George Riley died on January 19th at Victoria, at the age of 73. He was born in St. Catharines, Ont., where for some time he was engaged as a merchant. In 1885 he went to Victoria, where he became paymaster with the contracting firm of Bell, Larkin & Paterson, which was at that time engaged in the construction of the Esquimalt and Nanaimo Railway. This engagement marked the beginning of a successful business career extending over forty years.

The death is announced of Mr. G. Colin Carman, a well-known resident and civil engineer, of Cornwall, Ont., on January 21st, in his eightieth year. Mr. Carman was born in Cornwall, and commenced his professional career on the construction of the Intercolonial Railway, being assistant engineer on the section between Riviere du Loup and Hamilton, N.B. He was engaged in both the location and construction of the British Columbia end of the Canadian Pacific Railway, and was engineer in charge of the section on the Upper Fraser River, from Spence's Bridge to Yale. From 1890 to the time of his retirement a few weeks ago he was on the engineering staff of the St. Lawrence Canals. He was resident engineer in charge of the construction of the Sheik's Island Dam, and also had charge of the construction of the 800-foot lock at Iroquois on the Galops Canal.

Mainly Constructional

East and West—From Coast to Coast

The Bancroft Marble Quarry, Belleville, Ont., are working overtime in filling rush orders.

The Stratford, Ont., Builders' Exchange held a successful meeting on the 27th ult. in their rooms in the Worth Block.

The Sombra Township Council have recommended the appointment of Mr. George A. McCubbin as township engineer.

The building law of Fredericton, N.B., is to be amended, more restrictions being placed on the repairing of frame buildings.

The Frontenac Moulding and Glass Company, Limited, has been incorporated with a capital stock of $250,000 and head office at Toronto.

The second of the three spans of the new steel bridge being built at Trenton, Ont., to replace the historic wooden structure, is now placed.

Seven hundred and eighty-seven thousand five hundred and ninety-five dollars was spent on trunk sewers in Burrard Peninsula, B.C., during the year 1915.

The Bank of Hamilton announce their intention of razing their old building at Winnipeg and erecting a handsome five-storey structure on the same site.

The financial statement of the Canada Cement Company, Montreal, for the year 1915, shows net earnings of $1,724,013—an increase of $224,954 over those for 1914.

The Ontario Granite and Marble Workers' Association held their fourth annual banquet on February 1st in the Carls-Rite Hotel, Toronto. Sixty members were present.

In January, 1916, the city of Winnipeg issued nineteen building permits, of an aggregate value of $17,700. In January, 1915, the value of building permits issued was $14,800.

The new Welland Canal is rapidly nearing completion. Of the nine sections into which the 25-mile job is divided, the four most important and expensive are well under way.

The applications made to the Toronto city architect for building permits during the week ending February 26 showed a considerable advance on the previous two weeks. Forty-seven persons applied for permits, amounting to $137,340.

In a recent case at Windsor, Ont., the judge gave a ruling that where sidewalks were originally corrugated and have been allowed to wear smooth the city is responsible for accidents. This decision also applies to glass areas in the sidewalks in front of stores.

The annual meeting of the American Society of Civil Engineers was held in New York from January 14 to 21. The Society is in a flourishing condition financially, and its present membership is placed at 8,000. Mr. E. L. Corthell, of New York City, was elected president for the ensuing year.

Canada spent nearly twenty-five million dollars during the last fiscal year on capital account for Government railway construction and permanent improvements, and five and one-half millions on canals, bringing the total Government expenditure, prior to and since Confederation, on capital accounts for railways, up to $352,947,000, and for canals to $112,472,000.

The Elgin County Council have decided to pass a by-law to take advantage of the provision of the Highways Improvement Act in order to build good roads throughout the county. The by-law is not to become operative until January 1, 1917, and in the meantime a comprehensive plan will be prepared for designating the roads and the amount of improvements required.

Welland County Council have designated roads to be built on the county system this year estimated to cost $101,000. Last year $231,367.04 was expended on the good roads system, upon which the Government grant amounted to $77,222.35. About eighty-three miles has been completed to date out of a total of 133 miles, and the cost averages about $5,000 per mile.

Commissioner Harris does not recommend the installation of Imhoff tanks at the Toronto sewage disposal works—partly because he is not certain that this is the best system for overcoming the smell nuisance, and, partly on account of the cost, which would be from five to six million dollars. In his opinion the activated sludge process with which the city is experimenting offers better promise of results.

Among the new companies recently registered at Halifax, N.S., under the Joint Stock Companies Act is Plaster Quarries, Limited, a corporation formed to acquire and take over from G. C. Fletcher a gypsum deposit at Island Point, C. B., and manufacture and deal in gypsum and its products. Registered office at Sydney. Capital $300,000 in 300,000 shares. Shareholders named: Wm. A. Wood, Wm. Johnson, Jr., and Alexander Campbell, Montreal.

Subletting of Manitoba Government contracts will be made practically impossible by a bill called a "Fair Wage Act" which the Hon. T. H. Johnson has introduced into the Manitoba legislature. It provides for the establishment of a fair wage board to draw up a fair-wage schedule annually, and in order to hold employers responsible for the conditions it declares that government contracts may not be sublet, assigned, or otherwise disposed of except with the consent of the minister. Assignments for the benefit of creditors may be made, but no others unless the approval of the minister has first been obtained.

The Shawinigan Laboratories, Limited, has been formed, with a capital of $25,000, for research purposes in connection with electro chemical, mechanical, electrical, metallurgical and electro-metallurgical engineering. Messrs. Howard Murray, W. S. Hart, Julian C. Smith, J. C. King, and F. T. Kaelin, of the Shawinigan Water and Power Company, are among the incorporators. It is proposed to continue operations at Shawinigan Falls, where much experimental and research work has been carried out in the laboratories. It will be remembered that some of the gentlemen named are interested particularly in the establishment of electric furnaces for the manufacture of high grade steel.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Brooke Township, Ont.
The Township Council propose to repair the Zavitz Drain and to make other improvements. Clerk, W. J. Weed, Alvinston.

Burlington, Ont.
The Town Council will call for new tenders on the supply of concrete pipe in the early spring. Clerk, James S. Allen.

Dereham Township, Ont.
The Township Council intend to purchase a quantity of tile for drains to be constructed shortly. Clerk, Alexander Bell, Dereham Centre.

London, Ont.
The Waterworks Board are having plans prepared for water supply and service mains to be laid in various parts of the city. Estimated cost, $18,500. Chairman, Philip Pocock.

The London Street Railway contemplate paving the track allowance on streets where new pavements are laid. Particulars from C. B. King, Dundas Street E. Vitrified brick will be used.

New Toronto, Ont.
The Village Council are considering the construction of an addition to the waterworks plant in order to double its present capacity of 750,000 gallons. Superintendent, Hugh Thomas.

Ottawa, Ont.
Plans are being prepared for a tile sewer to be laid on Lyon Street for the City Council. Engineer, F. C. Askwith.

Peterborough, Ont.
The City Council will call for tenders on the supply of cement and sewer pipe during the year. Specifications not yet prepared. Engineer, R. Parsons.

Sault au Recollet, Que.
The Town Council are seeking permission to borrow $250,000 for the construction of sewage and water systems and a filtration plant.

St. Marys, Ont.
The installation of an auxiliary pumping plant at an approximate cost of $8,000 is being considered by the Town Council. Clerk, Thomas M. Clark. Gasoline engines may be used.

Toronto, Ont.
The York County Council will be requested by the Municipalities in North York to plan a better road system, involving the expenditure of $500,000. Clerk, R. W. Phillips, 57 Adelaide Street East.

Welland, Ont.
The Welland County Council have decided to construct about 20 miles of roads during next season at an estimated cost of $101,000. Superintendent, James Sheppard, Queenston.

CONTRACTS AWARDED

Toronto, Ont.
Contracts for the construction of sewers have been let by the Board of Control to W. E. Taylor, 438 Clinton Street, the Grant Contracting Company, 50 Front Street E., and to the Commissioner of Works.

Windsor, Ont.
The contract for the construction of sewers on Parent and Tiles Streets for the City Council has been let to Merlo, Merlo & Ray, Tecumseh Road. Brick construction. Approximate cost, $37,000.

Railroads, and Bridges Wharves

Ashfield Township, Ont.
The Township Council propose to build a new bridge across Nine Mile River to replace that recently destroyed. Clerk, T. G. Allen, Dungannon, Ont.

Bowmanville, Ont.
The Department of Public Works Ottawa, propose to repair the pier at an approximate cost of $10,000. Secretary, R. C. Desrochers.

Collingwood, Ont.
The sum of $75,000 for harbor improvements has been included in the year's estimates by the Department of Public Works, Ottawa.

Euphemia Township, Ont.
The erection of a number of bridges is being considered by the Township Council. Clerk, D. M. Smith, Cairo, Ont.

Guelph, Ont.
The Canadian Pacific Railway Company, Montreal, contemplate laying a double track between Guelph Junction and London this summer.

Hamilton, Ont.
The Dominion Government have included in their estimates for the year the sum of $250,000 for the construction of docks, etc., at Stipes Inlet. Survey work will start shortly.

Kingston, Ont.
The construction of harbor improvements estimated to cost $120,000 is contemplated by the Dominion Government Department of Public Works.

Leamington, Ont.
The Department of Public Works, Ottawa, have included in their estimates the sum of $10,000 for the construction of a breakwater.

Leith, Ont.
The reconstruction of the wharf at an approximate cost of $10,000 is contemplated by the Department of Public Works, Ottawa.

London, Ont.
A report on the construction of a breakwater at Front Street will shortly be submitted to the City Council. Approximate cost of work, $12,000. Engineer, H. A. Brazier.

Newcastle, Ont.
The estimates of the Dominion Department of Public Works include $17,500 for repairs to the pier.

Oshawa, Ont.
The Department of Public Works, Ottawa, propose to construct harbor improvements at an estimated cost of $50,000.

Peterborough, Ont.
The construction of a dry dock at an approximate cost of $25,000 is contemplated by the Dominion Department of Public Works.

Peterboro & Victoria Counties, Ont.
The County Councils are considering the question of repairing or rebuilding the bridge over Pigeon Creek. Estimated cost of repairs, $12,000, and of a new bridge, $85,000. Clerks, E. M. Elliott, Peterboro, and J. R. McNeillie, Lindsay.

Port Dover, Ont.
Harbor improvements, estimated to cost $50,000, are contemplated by the Department of Public Works, Ottawa.

Port Elgin, Ont.
The Department of Public Works, Ottawa, propose to renew the breakwater at an estimated cost of $10,500.

Sault Ste. Marie, Ont.
The Dominion Department of Public Works propose to make repairs to the wharf this year. Estimated cost, $5,000.

Toronto, Ont.
Plans are being prepared for a bridge across Reservoir Ravine and another over the Belt Line Ravine. Commissioner of Works, R. C. Harris.

Wardsville, Ont.
The City Council have let the contract for steel work required in the erection of a bridge to A. Hill & Company, Mitchell, Ont., at $3,347, and for concrete abutments and flooring to William Irwin, 59 Curtis Street, St. Thomas.

Public Buildings, Churches and Schools

Ailsa Craig, Ont.
The School Trustees propose to veneer the school with red pressed brick at an approximate cost of $3,500. Chairman, Neil McLachlan.

Athol Township, Ont.
The report published in our issue of January 26th to the effect that the Trustees of Athol Section No. 1 were considering the erection of a school, is incorrect. No school will be built.

Berthier, Que.
The Berthier Parish School Board will

shortly call for tenders on the erection of a school. Estimated cost, $4,000. Secretary, J. A. A. Lavallee, Berthier.

Brantford, Ont.
The erection of a drill hall is contemplated by the Department of Public Works, Ottawa. Estimated cost, $75,000.

Brussels, Ont.
The Department of Public Works, Ottawa, have included the sum of $22,500 in the year's estimates for the erection of public buildings. Secretary, R. C. Desrochers, Ottawa.

Burk's Falls, Ont.
The Department of Public Works, Ottawa, contemplate the erection of a Post Office at an approximate cost of $20,000.

Cannington, Ont.
The erection of public buildings at a cost of $8,000 is contemplated by the Department of Public Works, Ottawa.

Cobourg, Ont.
Provision has been made in this year's estimates of the Department of Public Works, Ottawa, for the erection of a public building at an approximate cost of $25,000.

Copper Cliff, Ont.
The Department of Public Works, Ottawa, propose to erect a public building at a cost of about $15,000.

Delaware, Ont.
Interior alterations and decorations to St. Andrew's Church are being considered. Pastor, Rev. W. Rayson. Architect not yet appointed.

Dunnsville, Ont.
The erection of public buildings at a cost of $20,000 is proposed by the Department of Public Works, Ottawa.

Durham, Ont.
The Department of Public Works, Ottawa, propose to build a public building. Approximate cost, $24,000.

Exeter, Ont.
The erection of a public building at an estimated cost of $15,000 is contemplated by the Department of Public Works, Ottawa.

Forest, Ont.
The Department of Public Works, Ottawa, propose to erect a public building. Estimated cost, $20,000.

Fort William, Ont.
The erection of a drill hall is contemplated by the Department of Public Works, Ottawa. Approximate cost, $30,000.

Galt, Ont.
The Department of Public Works, Ottawa, contemplate the erection of a drill hall at an approximate cost of $6,000.

Georgetown, Ont.
The erection of a public building is contemplated by the Department of Public Works, Ottawa. Estimated cost, $20,000.

Gore Bay, Ont.
The sum of $5,000 has been included in the estimates of the Dominion Department of Public Works for the erection of a public building.

Gravenhurst, Ont.
The Department of Public Works, Ottawa, propose to erect a public building at an estimated cost of $20,000.

Hespeler, Ont.
The erection of a public building to cost about $22,000 is contemplated by the Dominion Government Department of Public Works.

Huntsville, Ont.
The erection of a public building at an approximate cost of $20,000 is contemplated by the Department of Public Works, Ottawa.

Ingersoll, Ont.
The Department of Public Works, Ottawa, contemplate the construction of a drill hall at an estimated cost of $25,000.

Kenora, Ont.
The erection of a drill hall is contemplated by the Dominion Government Department of Public Works. Approximate cost, $20,000.

Kingston, Ont.
The Department of Public Works, Ottawa, have included in their estimates the sum of $15,000 for the erection of a drill hall for the R. M. C.

King Township, Ont.
The Trustees of School Section No. 14 have decided not to erect a school this year, but will proceed with the work when conditions improve.

Kingsville, Ont.
The Department of Public Works, Ottawa, propose to erect a public building at an estimated cost of $20,000.

Lindsay, Ont.
The Public Works Department, Ottawa, contemplate alterations to the public building, estimated to cost $7,000.

London, Ont.
The erection of an addition to the Armory is contemplated by the Dominion Department of Public Works. Approximate cost, $50,000.

The Department of Militia are having plans prepared for the erection of a Home for Invalid Soldiers. Work will start as soon as possible. Frame construction, felt and gravel roofing. Architect, A. E. Nutter, Dominion Bank Building.

McGillivray Township, Ont.
The erection of a school is being considered by the Trustees of School Section No. 6. Secretary, J. L. Amos, Ailsa Craig.

Meaford, Ont.
The sum of $10,000 for the erection of a public building has been included in the year's estimates by the Public Works Department, Ottawa.

Medicine Hat, Alta.
The Public School Board are considering the erection of a technical school at an approximate cost of $100,000. Modified plans have been prepared by W. H. Bourne, Huckvale Block, and submitted to the Board. Work will start in the spring if financial matters can be arranged.

Mill Brook, Ont.
The Dominion Department of Public Works propose to erect a public building at an approximate cost of $20,000.

Milverton, Ont.
The erection of a public building is contemplated by the Department of Public Works, Ottawa. The sum of $5,000 has been included in the estimates for this purpose.

Morrisburg, Ont.
The Dominion Department of Public Works propose to build a public building at an approximate cost of $20,000.

Ottawa, Ont.
Sketch plans for sun parlors to be built at the Isolation Hospital for the Health Department are being prepared by J. A. Ewart, Booth Building, and Millson & Burgess, Union Bank Building.

The erection of a drill hall at an approximate cost of $50,000 is contemplated by the Public Works Department, Ottawa.

Owen Sound, Ont.
The erection of a drill hall is contemplated by the Department of Public Works, Ottawa. Estimated cost, $25,000.

Parry Sound, Ont.
The Dominion Public Works Department propose to erect a public building at an estimated cost of $20,000.

Pembroke, Ont.
The erection of a drill hall to cost about $4,000 is contemplated by the Department of Public Works, Ottawa.

Perth, Ont.
The Dominion Department of Public Works contemplate the erection of a public building at an approximate cost of $25,000.

Peterborough, Ont.
The sum of $47,000 has been included in the year's estimates by the Department of Public Works, Ottawa, for the erection of a public building.

Port Credit, Ont.
The Department of Public Works, Ottawa, propose to construct harbor improvements at an estimated cost of $40,000.

Toronto, Ont.
The erection of a small church is contemplated by the Earlscourt Baptist Congregation, and a site has been purchased. Pastor, Rev. W. F. Roadhouse, 33 St. Clair Gardens.

CONTRACTS AWARDED

Charlottetown, P.E.I.
The contract for installation of seating at the First Methodist Church has been awarded to the Valley City Seating Company, Hatt Street, Dundas Ont. Tenders are now being received for lighting, painting and decoration.

McGregor, Ont.
The general contract for remodelling the church has been awarded to Pennington & Brian, 47 Sandwich Street East, Windsor. Work consists of the installation of a heating system.

Business Buildings and Industrial Plants

Belleville, Ont.
Charles S. Clapp contemplates the erection of an addition to a store on Bridge Street.

Brandon, Man.
Doig, Rankin & Robertson intend to rebuild their store which was recently

destroyed by fire. Work will start in the spring.

Bridgewater, N.S.
W. E. Awalt is having plans prepared for rebuilding the Fairview Hotel along modern lines.

Dundas, Ont.
Tenders on the erection of an office and warehouse for the Public Utilities Commission will be received until February 12th by the Secretary, James McGinty. Red pressed brick construction, concrete foundation. Approximate cost, $4,500.

Fred Church has commenced the erection of an addition to his garage. Red brick construction, concrete foundation.

Fergus, Ont.
T. D. Hume, Argo Block, intends to remodel premises which he has purchased for a picture show. Work will include the construction of a gallery and installation of seating.

Jasper, Alta.
Plans have been prepared for a hotel to be built for the Grand Trunk Pacific Railway, Montreal. Work will start in the spring if plans are approved by the President. General Manager, M. Donaldson, Winnipeg.

Kamloops, B.C.
The Board of Trade are considering the construction of a creamery. Secretary, F. Dennison.

Kensington, Ont.
The Department of Public Works, Ottawa, contemplate the erection of a wharf and warehouse at an estimated cost of $10,000. Secretary, R. C. Desrochers.

Lake Louise, Alta.
Tenders will be received until February 14th on the erection of a hotel kitchen and store building for the Canadian Pacific Railway Company, Montreal. Architects, Barott, Blackader & Webster, New Birks Building, Montreal. Reinforced concrete construction, felt and gravel roofing.

Leamington, Ont.
The Leamington Agricultural Society propose to build an agricultural hall at the Fair Grounds this summer. Vice-President, Louis Smith.

London, Ont.
The City Council are considering the erection of a storage building and stables for the Garbage Department. Clerk, S. Baker.

Plans are to be prepared for alterations to a store for Miss F. Mitchell, 114 Dundas Street. Work may start in the spring. Terra cotta construction. Estimated cost, $10,000.

The addition to the roof garden which is to be built at the premises of Smallman & Ingram, Dundas Street, will be of steel and glass construction.

W. Thornton, Callaghan Terrace, Ridout Street, is having plans prepared for alterations to the terrace.

The Kerwood Creamery Company, c/o J. Waddell, are considering the equipment of a branch plant here.

Lucan, Ont.
Smith & McComb have secured premises which they intend to equip as auto sales rooms.

Montreal, Que.
All trades required in the erection of stores and residences on Church Street will be done by the owner, N. D. Leger, 2516 Chateaubriand Street.

Niagara Falls, Ont.
The erection of a garage is being considered by M. H. Buckley, 20 Ontario Avenue. Reinforced concrete construction. Estimated cost, $6,000.

Penticton, B.C.
The Kettle Valley Railroad propose to extend their machine shop and to erect an ice-house. General Manager, J. J. Warren, Penticton.

Prescott, Ont.
New specifications have been prepared for the installation of a heating plant at the premises of the Newell Manufacturing Company, and tenders will be called shortly. Engineer, W. H. Wardwell, 413 New Birks Building, Montreal.

Renfrew, Ont.
The South Renfrew Agricultural Society propose to build an agricultural hall at the Fair Grounds, at an approximate cost of $3,000. Secretary, W. E. Smallfield, Coumbe Street.

Sarnia, Ont.
The sum of $50,000 for the construction of a wharf and shelter basin has been included in this year's estimates by the Department of Public Works, Ottawa. Secretary, R. C. Desrochers.

Springfield, Ont.
John Benton, Townline West, Springfield, contemplates the construction of a fireproof stock barn. Estimated cost, $3,000.

Squamish, B.C.
H. Butterfield, Squamish, is considering the erection of a shingle mill on the Pillchuck River.

Toronto, Ont.
The Board of Control will receive tenders until February 15th for the erection of a shed at the Civic Abattoir. Plans and specifications at office of the City Architect. Steel frame, galvanized iron construction.

The Dominion Realty Company, 34 King Street West, are about to commence alterations to the old McConkey Building, 31 King Street W., for the Canadian Bank of Commerce. Estimated cost, $10,000.

Vancouver, B.C.
W. F. Gardiner, Architect, 347 Pender Street West, is receiving tenders on the erection of a theatre at Broadway and Main Streets for C. M. Bowman, Albert Street, Southampton, Ont. Estimated cost, $40,000. Steel and brick construction, stone trimmings.

Windsor, Ont.
The Maxwell Motor Company, Detroit, Mich., are considering the erection of a factory at an estimated cost of $45,000. Site has been purchased and work will start shortly in charge of the E. E. Sheldon Construction Company. Reinforced concrete and brick construction, concrete foundation.

The Universal Stove & Furniture Company, Limited, contemplate the erection of a factory in this neighborhood, but have not yet decided upon the location. Temporary office, 77 Sandwich Street E.

CONTRACTS AWARDED

Esquimalt, B.C.
The sub-contract for structural steel required in the erection of an oil storage plant for the Imperial Oil Company, Limited, 404 Abbott Street, Vancouver, has been awarded to J. Coughlan & Sons, 500 Beatty Street.

Hays Cove, B.C.
The general contract for the erection of an office building and warehouse for the Imperial Oil Company, Limited, 404 Abbott Street, Vancouver, has been awarded to Mitchell & Currie, Prince Rupert, B.C. Approximate cost, $18,000.

Montreal, Que.
In connection with the repairs to the business block at 91 Notre Dame Street W., the contract for plastering has been let to George H. Knott & Company, Chestnut Avenue, and the plumbing to J. A. Gordon, 301 St. Antoine Street. Roofing and painting not yet awarded.

The general contract for repairs to the grand stand at Blue Bonnets Race Track for the Montreal Jockey Club has been awarded to Reid, McGregor & Reid, Drummond Building, and the steel contract to Structural Steel Company, Limited, New Birks Building.

The general contract for repairs to the business block at 91 Notre Dame Street West has been let to D. M. Long, 204 William Street.

Regina, Sask.
The Royal Bank of Canada, Montreal, have awarded the general contract for the erection of a branch building at Eleventh and Hamilton Streets to Purdy & Henderson Company, Limited, 10 Cathcart Street, Montreal. Contractors are now arranging for sub-contracts. Work will start in the spring. Approximate cost, $50,000.

Sherbrooke, Que.
In connection with the addition now being built at the premises of Walter Blue & Company, Limited, 8 King St., the contract for roofing has been awarded to George W. Reed & Company, 37 St. Antoine Street, Montreal, and the painting to the general contractors, Anglin's Limited, 65 Victoria Street, Montreal.

Three Rivers, Que.
The general contract for alterations to a garage for C. O. Baptist, 6 Du-Fleuve Street, has been let to B. J. Trepanier, 24 Niverville Street. Estimated cost, $7,000.

Toronto, Ont.
The Board of Control have awarded the contract for the installation of additional cold storage equipment at the Civic Abattoir to the Canadian Ice Machine Company, Limited, 82 Chestnut St.

Work is progressing on alterations to a store at 446 Spadina Avenue for H. Lucas, 141 Havelock Street. The general contract has been let to Painter & Son, 333 Huron Street, and the painting and decorating to James Kitchener, 418 Spadina Avenue.

Vancouver, B.C.
In connection with the bank building now in course of erection at Granville and Pender Streets for the Merchants

Bank of Canada, Montreal, the contract for marble work has been let to the Continental Marble Company, Rogers Building, the mill work to Robertson & Hackett, Granville Street Bridge, and the plastering to H. C. Wood, 4478 Walden Street.

The contract for roofing and sheet metal work required in connection with the additions to the store of the Hudson's Bay Company, Georgia Street, has been let to the British Columbia Ceiling & Roofing Company, 523 Seventh Avenue W., and the plastering to E. C. McDougall, Holden Building. Tenders on painting and glass work are now being received by the general contractors, British Columbia Construction & Engineering Company, 516 Standard Bank Building.

Residences

Amherstburg, Ont.
Sketch plans are being prepared for a residence to be erected for Charles Hackett. Stucco and brick construction, concrete foundation, shingle roofing. Estimated cost, $6,000. Architect, J. C. Pennington, La Belle Building, Windsor.

Blenheim, Ont.
Plans are being prepared for a residence to be erected on Chatham Street for W. J. Grant, Sheldrick Street. Estimated cost, $3,500.

D'Israeli, Que.
J. A. Bengle proposes to rebuild his residence. Frame construction. Estimated cost, $4,000. Work will start about May 1st.

Huntsville, Ont.
Tenders on the erection of a cottage for J. S. Barker, 8 Park Place, St. Catharines, are being received by the Architect, T. H. Wiley, 128 St. Paul Street, St. Catharines.

Inwood, Ont.
Jacob Wright is preparing plans for a residence, estimated to cost $3,000.

London, Ont.
The Copp Syndicate, c/o A. M. Hunt, Dominion Savings Building, are considering the erection of five more residences as soon as those now in course of construction are finished. Red pressed brick construction. Estimated cost, $15,000.

W. J. Blackie, Cheapside and Richmond Streets, is considering the erection of three residences on Victoria Street.

The erection of a twelve-suite apartment house on St. James Street is being considered. L. H. Martyn, 807 Princess Avenue, is an interested party. Approximate cost, $15,000.

Mildmay, Ont.
J. Hesch, Sr., contemplates repairs to his residence which was recently damaged by fire. Work will start in the spring.

Montreal, Que.
D. Peloquin, 449 Old Orchard Avenue, has commenced the erection of two residences, estimated to cost $8,000. Subtenders on smaller trades are now being received. Brick construction, concrete foundation, felt and gravel roofing.

In connection with the residence which is now being built on Marlowe Avenue for A. H. Brittain, 3 St. Nicholas Street, sub-tenders are now being received for roofing and electrical work. General contractors, Anglin's Limited, 65 Victoria Street, Montreal.

O. Germain, 79 St. Catherine Street, is building a residence at St. Catherine and Maisonneuve Streets, estimated to cost $5,000. Brick veneer construction.

Sarnia, Ont.
All work required in connection with the residence now in course of erection for S. Scarlatta, 165 Lochiel Street, will be done by the general contractor.

Toronto, Ont.
Work on the erection of a residence on Silver Birch Street has been started by J. T. Moore, 30 Bertmount Avenue. Smaller trades will be let. Brick construction, shingle roofing. Estimated cost, $3,000.

S. B. Green, 111 Evelyn Crescent, is building two residences on High Park Boulevard, estimated to cost $6,200. Stone and brick construction, stone foundation, shingle roofing.

Work has been started by H. B. Jackson, 134 Bracken Avenue, on the erection of a residence at 315 Beech Avenue. Smaller trades will be let. Brick construction, shingle roofing. Estimated cost, $3,000.

The Board of Control will receive tenders until February 15th for the installation of sanitary conveniences at a number of houses. Specifications, etc., at office of the Health Department.

A. D. Richards, 33 Westmount Street, is building a residence at 28 Glenholme Avenue, estimated to cost $3,750. Brick construction, slate roofing.

Walkerville, Ont.
Plans are being prepared for a bungalow to be built on Lincoln Road by the Burns & Walker Construction Company, Tuson Building, Windsor. Frame construction, concrete foundation, shingle roofing. Architects, Walker & McPhail, Tuson Building, Windsor. Approximate cost, $3,500.

Woodroffe, Ont.
C. A. Wallace, Richardson Avenue, is building a residence, estimated to cost $3,500. Brick veneer construction, concrete foundation, shingle roofing.

CONTRACTS AWARDED

Bowmanville, Ont.
Work is progressing on alterations to a residence for R. J. Gill, Bowmanville. The masonry, carpentry, roofing, plastering and painting have been let to A. E. Gilders, Bowmanville, and the heating to the James Smart Manufacturing Company, Gourley Street, Brockville. Milton brick construction, concrete foundation, asbestos shingle roofing. Estimated cost, $7,000.

Ingersoll, Ont.
Plans have been prepared for three cottages to be built on King Street W. for John Stadhauser, and the general contract let to R. Layton. Smaller trades will be sub-let by the general contractor. Frame and mill construction, concrete foundation, shingle roofing. Approximate total cost, $4,500.

Montreal West, Que.
Work has been started by Anglin's Limited, 65 Victoria Street, Montreal, on the erection of a residence on Wolseley Street for C. G. Higginson, 2435 Park Avenue, Montreal. Brick construction, concrete foundation, slate roofing. Subtenders on roofing and electrical work are being received. Approximate cost, $6,500.

Ottawa, Ont.
The general contract for the erection of apartments on Somerset Street for W. H. Tate, Bank Street, has been let to J. D. & F. Wilson, 482 Bank Street; brick work to James Paterson, 33 Fulton Street; galvanized iron work and roofing to McFarlane & Douglas Street, and heating and plumbing to J. T. Blyth, Frank Street. Electrical work not yet awarded. Approximate cost, $6,000.

The general contract for the erection of a residence for William Eastman, 22 Ossington Avenue, has been awarded to Bower Bros., 133 Hopewell Street. Brick veneer construction, stone foundation, shingle roofing. Estimated cost, $5,000.

Yarmouth, N.S.
A. W. Nowlan, Wellington, N. S., is building a bungalow for William Churchill. Frame and shingle construction. Estimated cost, $3,000.

Power Plants, Electricity and Telephones

Dunwich Township, Ont.
The Dunwich Rural Telephone Company propose to make improvements to their system in the spring. Secretary, D. A. McNabb, Dutton, Ont.

Goderich Township, Ont.
The Goderich Township Telephone Company propose to construct extensions and other improvements in the spring. Secretary, E. H. Wise, Homesville, Ont.

Hensall, Ont.
The by-law authorizing the installation of hydro power and lighting system has been carried. Town Clerk, A. Murdock.

Inwood, Ont.
The Village Council are considering the installation of a hydro lighting and power system. Clerk, W. J. Weed, Alvinston, Ont.

London, Ont.
The City Council have decided that the proposed ornamental lighting system on Talbot and King Streets shall be installed by General Manager E. V. Buchanan. Cost to be between $2,700 and $3,500.

Melbourne, Ont.
The Caradoc Ekfrid Telephone Company intend to extend and improve their system in the spring. Secretary, G. W. Sponenburgh, Melbourne.

McKillop Township, Ont.
The McKillop Telephone Company are considering improvements, repairs and extensions to their system. Particulars from J. M. Govenlock, Seaforth, Ont.

Ontario Province.
The Malahide & Bayham Telephone Company propose to extend their system to connect with the Aylmer and Tillsonburg System. Particulars from C. A. Wellington, Richmond, Ont.

(Continued on page 50)

Tenders and For Sale Department

Hydro Tenders Wanted

Sealed tenders, marked "Tenders for Lead Covered Cable," addressed to the Chairman, The Toronto Electric Commissioners, will be received until noon, **Wednesday, February 16, 1916.** Each tender must be accompanied by a marked cheque as called for in the form of tender. Specifications and form of tender can be obtained at the office of the purchasing Agent, 15 Wilton Avenue. The lowest or any tender not necessarily accepted. 6-6

Hydro Tenders Wanted

Sealed tenders, marked "Tenders for Pole Type Transformers," addressed to the Chairman of the Toronto Electric Commissioners, will be received until noon on **Wednesday, February 16, 1916.** Each tender must be accompanied by a marked cheque, as called for in the form of tender. Specifications and form of tender can be obtained at the office of the Purchasing Agent, 15 Wilton Avenue. The lowest or any tender not necessarily accepted. 6-6

CITY OF MONTREAL

Refined Asphalt

Tenders, under sealed envelope, addressed to the Board of Commissioners and deposited in their office, at the City Hall, will be received until noon, **Thursday, February 24th, 1916,** for the supply and delivery of refined asphalt.

The quantity anticipated is about six thousand (6,000) net tons. It is distinctly understood that this quantity is but approximate, and the Board of Commissioners reserves the right to increase or decrease said quantity in any amount at its discretion without entitling the Contractor to any claim whatsoever.

Copies of specifications and forms of tenders may be obtained by the interested parties at the office of the Superintendent of Purchases and Sales, and all necessary information will be given at the Chief Engineer's Office.

All tenders not made on the form furnished for that purpose by the City of Montreal, and not sent in the printed envelope also furnished for that purpose shall not be entertained.

No tenders shall be considered unless the same be accompanied by a cheque accepted by an incorporated Canadian Bank payable to the City of Montreal, for a sum representing 10 per cent. of the total amount of the tender, which tender and cheque shall be enclosed in said envelope.

The lowest or any tender will not necessarily be accepted.

The tenders will be opened in the presence of the interested parties by the Board of Commissioners deliberating in its Meeting Room, at the City Hall, at the first regular meeting of the said Board, following the reception of the said tenders or on the date above mentioned, if the Board is sitting.

By order of the Board of Commissioners.

L. N. SENECAL, Secretary.

Board of Commissioners' Office,
City Hall,
Montreal, February 1st, 1916. 6-7

WANTED

Six contractors' dump cars and dinkey. Give particulars. Box 313, Contract Record, Toronto, Ont. 6-7

Tenders Wanted

Sealed tenders for all trades, with the exception of structural steel, in connection with the erection of the New Princess Theatre, Toronto, will be received until 5 p.m., **Saturday, February 12, 1916,** at the office of the undersigned.

Structural steel tenders will close at 5 p.m., Saturday, February 5, 1916.

Tenders to be submitted on forms to be supplied.

Plans and specifications may be seen at the office of Charles J. Read, Rooms 203-4 Confederation Life Building, Toronto, Ont.

C. HOWARD CRANE, Architect,
CHARLES J. READ, Associate Architect.
4-5-6

Sealed tenders addressed to the undersigned, and endorsed "Tender for Lock Gates at East River Lock, N.S.," will be received at this office until 4 p.m., on **Monday, February 28, 1916,** for the construction of Timber Lock Gates and their equipment for the East River Lock, near New Glasgow, Pictou County, N.S.

Plans and forms of contract can be seen and specification and forms of tender obtained at this Department, and at the offices of the District Engineers at Antigonish, N.S.; Halifax, N.S.; Shaughnessy Building, Montreal, P.Q.; Confederation Life Building, Toronto, Ont., and on application to the Postmaster at New Glasgow, N.S.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be **given.**

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

NOTE.—Blue prints can be obtained at the Department of Public Works by depositing an accepted bank cheque for the sum of **$20.00,** made payable to the order of the Honourable the Minister of Public Works, which will be returned if the intending bidder submit a regular bid.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, January 27, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—91583. 5-6

For Sale

Large manufacturing company in the United States specializing in concrete machinery wants to sell outright a full set of drawings, patterns, and other information in reference to building and marketing concrete mixers. Good opportunity for Canadian manufacturer. Box 296, Contract Record and Engineering Review, Toronto, Ont. 4-6

Notice to Contractors

Supplies Wanted

Sealed tenders addressed to the Chairman and Members of the Water Works Committee will be received by the Secretary of the Water Works Committee, City Hall, Ottawa, up to 4 p.m., **February 24th, 1916,** endorsed "Tender for Brass-work, Cast Iron Pipe, Lead Pipe and Pig Lead, Oils and Grease, Special Pipe Castings or Valves," as the case may be.

Any tender received after the above stated time will be declared informal.

Specifications, Form of Tender and full particulars may be obtained on application to the City Engineer's Office, City Hall, Ottawa.

The Corporation does not bind itself to accept the lowest or any tender.

R. L. HAYCOCK,
Acting W. W. Engineer.

Ottawa, February 4th, 1916. 6-6

Township of Brantford

Fonger and Barton Bridges

Sealed tenders, clearly endorsed on the outside, will be received up to noon on **Saturday, February 26th, 1916,** addressed to the Township Clerk, County Building, Brantford.

"A"—For reinforced concrete abutments for Fonger Bridge, containing 225 cubic yards of concrete, and 18,000 lbs. square cold twisted steel reinforcement.

"B"—For steel superstructure, Class "A" loading, clear waterway 70 feet, clear roadway 16 feet, with reinforced concrete deck and latticed handrailings.

"C"—For reinforced concrete abutments for Barton Bridge, containing 165 cubic yards of concrete and 11,500 lbs. square cold twisted steel reinforcement.

"D"—For steel superstructure, Class "A" loading, clear waterway 80 feet, clear roadway 16 feet, with reinforced concrete deck and three line pipe handrailing.

Each tender must be on the prescribed form and accompanied by a marked cheque for 5 per cent. of the amount of the tender, made payable to the Treasurer of the Township of Brantford.

Plans and specifications may be seen at the office of the undersigned, Room 4, Temple Building, Brantford, from whom tender forms may be had.

ALAN MAIR JACKSON,
Township Engineer.
6-7

POSITIONS VACANT

CITY ENGINEER WANTED.—Applications for position of city engineer will be received until **March 1st, 1916.** Salary, $1,800 per annum. Send copies, not originals, of references, etc. Jos. McCartney, City Clerk, Galt, Ont. 5-6

AGENTS WANTED

Canadian sales agents wanted by large company manufacturing road making and contractors' machinery. Box 297, Contract Record and Engineering Review, Toronto, Ont. 4-7

Quarry Machinery For Sale

1—No. 6 Kennedy Crusher with extra shaft and head; capacity 50 to 80 tons per hour.
1—revolving screen.
1—main drive belt.
1—60-ft. elevator complete.

For particulars address Box 311, Contract Record, Toronto, Ont. 6-7

Made in Canada

Kennedy Road, Scarboro Township,
York County, Ontario.
Tarvia filled macadam.

Cheaper than Plain Macadam—

TARVIA is always cheaper in the long run to bond a macadam road with than water. Sometimes Tarvia as a binder does not add anything to the first cost.

The York County Highway Board, York County, Ontario, built about five miles of Tarvia macadam in 1915 and found it two cents a square yard cheaper than water-bound macadam cost them in 1914.

Such figures are not unfamiliar. The Tarvia displaces a certain amount of stone and reduces the amount of rolling required. The excessive use of water, often difficult to provide, is done away with. The Tarvia often makes possible the use of a cheaper stone which may not make a good road by itself but will give excellent results when there is a Tarvia matrix to prevent internal attrition.

Plain macadam is not fitted to stand the stresses of modern traffic but a tarviated road is automobile-proof. The swiftly driven wheels which disrupt a plain macadam surface, merely roll down a tarviated macadam and make it smoother. The tarviated surface is waterproof and frost-proof, and will not ravel when rain torrents sweep down steep hills.

There are three kinds of Tarvia. "Tarvia-X" is very heavy and dense, used as a binder in road building as in the above instance, and the most thorough and permanent of the Tarvia treatments. "Tarvia-A" is a lighter grade, used for hot surfacing applications. "Tarvia-B", which is fluid enough to be applied cold with modern spraying apparatus, is for dust prevention and road preservation.

In addition to the five miles of "Tarvia-X" macadam mentioned above, the York County Highway Board in 1915 coated six and one-half miles of the Kingston Road with "Tarvia-B." This is one of the best roads leading out of Toronto.

Booklets on request. Address our nearest office.

Special Service Department.

This Company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested. If you will write to the nearest office regarding road problems and conditions in your vicinity the matter will have prompt attention.

THE PATERSON MANUFACTURING COMPANY, LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER

THE CARRITTE-PATERSON MANUFACTURING CO., LIMITED

ST. JOHN, N.B. HALIFAX, N.S. SYDNEY, N.S.

Power Plants, Electricity and Telephones

(Continued from page 46)

Tisdale Township, Ont.
A by-law authorizing the purchase of an electrically driven fire pump has been passed. Clerk, W. H. Wilson, South Porcupine, Ont.

Toronto, Ont.
Tenders on the supply of lead covered cable will be received until February 16th by the Toronto Hydro Electric Commissioneds, 226 Yonge Street. Specifications, etc., at office of the Purchasing Agent, 15 Wilton Avenue.

The Toronto Hydro Electric Commissioners, 226 Yonge Street, will receive tenders until February 16th on the supply of pole type transformers. Specifications at office of the Purchasing Agent, 15 Wilton Avenue.

Wheatley, Ont.
The Independent Telephone Company are considering improvements and extensions to their systems during the year. Secretary, J. W. Kennedy.

CONTRACTS AWARDED

Sherbrooke, Que.
The City Council have awarded the contract for the supply of transformers to the Canadian General Electric Company, 158 St. Antoine Street, Montreal.

Late News Items

Hespeler, Ont.
The tool factory of A. B. Jardine & Company, Guelph Street, has been destroyed by fire. Loss, $75,000, principally on the shell plant.

London, Ont.
Plans are being prepared by Watt & Blackwell, Bank of Toronto Building, for alterations to a store for Miss F. Mitchell, 114 Dundas Street. Estimated cost, $10,000.

McGillivray Township, Ont.
Plans are being prepared by F. W. Farncomb, Edge Block, London, for a drainage scheme to be constructed jointly by the Townships of McGillivray, East Williams and Stephen. Work will start in the spring. Approximate cost, $15,000.

Montreal, Que.
The Board of Control will receive tenders until February 15th for the erection of a pump house and installation of a pump for the Notre Dame de Grace Sewer. Specifications, etc., at office of the Engineer, D. McLeod, City Hall.

New Liskeard, Ont.
Fire has totally destroyed the business block owned by F. O'Brien. Loss, $50,000.

Ottawa, Ont.
The City Council have passed Waterworks Department estimates of $50,000 for short watermain extensions on various streets throughout the city and $189,000 for construction of watermains under the Lee Distribution Scheme. Engineer, R. L. Haycock.

Port Moody, B.C.
In connection with the construction of a steel plant and rolling mills for the Port Moody Steel Works, Limited, Standard Bank Building, Vancouver, the contract for erection of main building, construction of a wharf and pile driving has been awarded to Henry Peterson, 16 Hastings Street E., Vancouver.

St. Catharines, Ont.
The contract for masonry required in the erection of a shop for the Metal Drawing Company, Race Street, has been let to Newman Bros., 71 St. Paul Street, and the carpentry to R. B. Williams, Beecher Street. Work has been started. Steel sash will be purchased by the masonry contractor. Architect, A. E. Nicholson, Queen Street.

Walkerville, Ont.
William Woolat, Jr., Kildare Road, has commenced the erection of a residence, estimated to cost $6,000. Stucco and brick construction. Work is being done by the owner and S. Keyser, 92 Moy Avenue, Windsor.

Windsor, Ont.
Work is about to start on the erection of an addition to the agricultural building at the Race Track for the Windsor & North Essex Agricultural Society. The masonry contract has been let to R. Wescott, 55 Oak Avenue. Sub-contracts not yet awarded. Frame construction, concrete foundation, composition paper roofing. Estimated cost, $6,000.

Winnipeg, Man.
The Presbyterian Church at Point Douglas has been practically destroyed by fire. Loss, $15,000. The congregation intend to rebuild and work will probably start immediately. Pastor, Rev. R. Boyle.

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Vol. 30 **February 16, 1916** **No. 7**

Principal Contents

This is No Time to Take Chances

The British Empire, of which Canada is an important part, is in a death-grapple with Germany.

There is no possible reason for doubting that this same Germany will, if she can, destroy the power of England.

The destruction of British power inevitably means that Canada falls under the control of some other nation.

Ultimately, if not immediately, that nation would be Germany—for, if Germany wins this war and cripples England, there is not sufficient world-power to withstand her aggressions.

Neither is there any doubt that in starting this war the ultimate ambition of the present German military power was to subdue the whole world.

Of course this war has developed into a much bigger business than Germany dreamed when she willed it on Europe. She hoped to achieve her ambitions step by step. But the Allies unexpectedly forced her hand, and she is clever enough to grasp the situation. She sees it clearly to-day—now or never—life with power, or death with shame.

Germany therefore fights to-day a fight for very existence—the fight of a hungry, maddened jungle-beast thwarted of its prey and driven to bay.

Can we Canadians, as sane beings, fighting with such an opponent—clever, powerful, resourceful, unscrupulous, beast-like—can we, I say, afford to take any chances? I don't say that any man of German blood in the employ of the Government at Ottawa is disloyal to Canada—I don't know. But I do say—it's possible. I do say that in the breasts of these men love of their native land would be only human. I do say that, with the very best of intentions, these men of German extraction are more likely to be the medium through which important military information might leak out. I do say that Germany's methods in the conduct of this war, in many directions, have led us to view with an irrepressible feeling of suspicion the acts of even our closest friends who may have German blood in their veins. I am willing to admit that this feeling is often unjust; but Germany has willed it so—even as she willed the war.

The continuance of any men of German birth or close German connection in any position of trust in Canada is entirely indefensible. Remove them at once. Treat them with all courtesy, pay their salaries if you will, reinstate them when we've won the war, but now—remove them.

Make it as impossible for them to do us harm as if we believed them guilty of the desire.

We are taking a chance when our life is at stake. It is a foolhardy chance, because there is nothing to be gained. Remove them as a precautionary measure.

I know that I express the sentiments of more than ninety-nine per cent. of the people of Canada when I demand from our Government the instant removal of these men from office, the immediate institution of adequate protection of all our public buildings and works, and the immediate segregation of such small elements in our population as give indication of German sympathies and who, in so doing, may interfere with our recruiting or may hinder the progress of the war in the smallest measure whatsoever.

And this latter applies to Waterloo County as elsewhere. Why should one of the most loyal sections of the whole Dominion be singled out for the humiliations of the past few weeks? "He that is not with us is against us." High or low, rich or poor, let us not forget for an instant—it's a fight to the death.

Montreal Harbor Improvements

Two new main projects are dealt with in the annual report of the Montreal Harbor Commissioners. These are the erection of an eight-storey warehouse and the electrification of the harbor railway terminals. The Commissioners refer to the need of warehouse accommodation so that goods can be received during the summer months when freights are advantageous, and held in order to give speedy delivery when required. The Commissioners have had under consideration plans for an eight-storey warehouse, to be situated in a central position on the harbor. The warehouse would have all the advantages of modern design. A railway car elevator hoist would take cars to the unloading platforms at each floor. The Commissioners would undertake to handle freight by railway car from the sheds to the warehouse, or vice-versa. Cars for delivery to outside points could be loaded at the different floors and shipped without any intermediary cartage.

With regard to the electrification of the railway terminals, the report states: "The increase in the railway traffic of the port and the mileage of trackage in operation makes it important to proceed with the utmost despatch in establishing facilities which will not only retain Canadian trade, but which, by their superiority over those provided at competitive ports, will attract additional business. With this object in view the Commissioners have, during the past year, devoted much time and thought to a study of a scheme for the complete electrification of the harbor railway terminals, visiting and inspecting in the meantime the electric freight terminals of the New York Central, Pennsylvania, and New York, New Haven and Hartford Railroads. at New York, Oak Point, New Rochelle, etc., where the application of electricity had proved successful in the movement of freight at the various terminals. It was also ascertained that, in addition to the primary object of overcoming the smoke nuisance, the application of electricity had proved that it had, among many others, the following advantages over steam for railroad terminal traction:—Economy in operation and maintenance; flexibility of control; availability for immediate service; fewer units required for equal service; elimination of corrosion of steel and galvanized iron by acid gases; fire danger reduced; and standby losses much lowered. As a result of this investigation, an expert electrical engineer has, for some time past, been engaged in studying, on the ground, the railway conditions of the port, and preparing a report as to designs, types and estimates, upon receipt of which it is proposed, should the report confirm the conclusions arrived at by the Commissioners, to proceed at once with the work of completely electrifying the Montreal Harbor terminals, upon the consummation of which Montreal will have the distinction of being the first port in the world possessing a complete system of electrified freight terminals."

Included in the work to be done during 1916 is the reconstruction of the Victoria Pier, which will be completed during the present year, the development of this pier and the market basin giving 2,700 lineal feet of high level quays for the ocean steamers, with a depth of thirty-five feet at low water, and 4,000 lineal feet on low level quays for river vessels, ferries, etc. The program of the Commissioners also includes the lengthening of the King Edward, the Alexandra and Jacques Cartier piers to 1,200 feet each, continuation of the high and low level wharves, very large works to change the St. Mary's current, and a bridge across from the Mackay pier to St. Helen's Island and thence across to the South Shore. The proposed bridge will be ninety feet wide and will provide two footpaths, a roadway, street car tracks, and railway lines, the latter being electrified in the same manner as the rest of the harbor railways, and connecting up with railways on the South Shore. The electric engine used will be of the d. c. 1,200 volt locomotive type. It has a length of 39 feet 6 inches, a height over the cab of 12 feet 4 inches, and from the trolley to the ground of 14 feet 6 inches. The width over all is 10 feet 1 inch. The weight of the electrical equipment is 60,000 lbs., and of the mechanical equipment 140,000 lbs. The haulage capacity of the engine will be roughly about a thousand tons. A portion of the tracks along the main frontage will be elevated, while the remainder will be surface tracks.

The disbursements on capital account in 1915 were $1,850,001.40, on the following works of improvement:

Grain Elevators	$ 636,950.65
Wharves, Piers and Basins	565,683.72
Harbor Dredging	269,704.48
Real Estate	158,636.07
Harbor Railway	145,065.93
New Plant	37,265.17
Permanent Sheds and Hoists	36,695.38
Total	$1,850,001.40

A Conundrum of the Day

"Should the chief intelligence officer of the war department of Canada be a German, with brothers in the German army?

"Should there be other Germans in the Government service here? A number there are.

"Is Canada at war with Germany or playing marbles?"—Ottawa Journal.

Good! and for heaven's sake will Ottawa cease playing politics?

Toronto Branch C. S. C. E.

The regular monthly meeting of the Toronto Branch was held in the Society's rooms at the Engineers' Club, 90 King Street West, on Thursday, Feb. 10th. The recently elected chairman Mr. G. A. McCarthy occupied the chair. Mr. G. R. G. Conway, M. Can. Soc. C. E., consulting engineer, Toronto, gave an informal lecture on "Recent Dam Construction in British Columbia," with particular reference to work with which he has been associated as Chief Engineer of the B. C. E. R. Co.

The lecture was illustrated with a fine series of lantern views and described the construction of the Bear Creek Dam on Vancouver Island which forms one of a number of dams built for the storage of water at Jordan River, 40 miles west of the city of Victoria, for the hydro-electric plants of the British Columbia Electric Railway Company. This dam is 1,020 feet in length and 50 feet in height, with 2½ to 1 downstream slope and 3 to 1 upstream slope, and contains 148,400 cubic yards of material. The dam was built by the hydraulic process and impounds 328 million cubic feet of water, the top elevation being 1,483 feet above sea level.

Five miles below Bear Creek dam has been constructed the Jordon River dam of the "Ambursen" type, which is the highest dam in Canada, the extreme height being 128 feet. It is so far the second highest reinforced concrete dam that has been built, the highest being the LaPrele dam in Wyoming which has a maximum height of 136 feet. The Jordan River dam is 891 feet in length with a spillway 305 feet long provided with 8 feet of freeboard. It contains 21,200 cubic yards of concerte and 380 tons of reinforcing steel was used in its construction. The dam impounds 612 million cubic feet of water, the top elevation being 1,360 feet. From this dam the main water supply is delivered by flume to a forebay from which the penstock pipes are taken so as to utilise a head of 1,145 feet at the power house where impulse wheels have been installed to a capacity of 25,000 horsepower.

Mr. Conway also described the construction features of Coquitlam dam which impounds water for the Coquitlam-Buntzen hydro-electric project of the British Columbia Electric Railway Company. This

(Continued on page 160)

Conference on Road Construction

For Road Superintendents and Engineers of the Province of Ontario—A four-day lecture and discussion course, thoroughly practical in its nature, covering the requirements of country road construction in all its various phases—Mr. W. A. McLean, Deputy Minister of Provincial Highways, discusses "Road Laws"

The first conference on highway construction for County Road Superintendents and Engineers, held in Toronto in February, 1915, met with such success that it was decided to continue the course again this year. The second conference was held in Toronto last week, February 8th to 11th, and judging by the good attendance, the vigorous discussions and interchange of ideas among the engineers from many Ontario counties this conference will be even more fruitful of results than the first.

Aim of the Conference

The organization covers more especially the southern portion of the Province of Ontario. The need for uniformity of methods, and for a close personal understanding between the engineers of the Department of Highways and the County Superintendents is essential for the efficient prosecution of highway improvement. This has been very successfully met by these conferences, at which practical lectures on highway construction, maintenance, etc., covering the problems of the practical man on the road have been delivered and very thoroughly discussed. The following resume of the congress proceedings endeavor to cover in the main the points brought out in discussion. Mr. W. A. McLean, Deputy Minister of Highways for the Province of Ontario, presided throughout.

* * *

ROAD CONSTRUCTION AS GOVERNED BY TRAFFIC REQUIREMENTS

Mr. R. C. Muir, A. M. Inst. C. E., opened the conference with a paper on "Road Construction as Governed by Traffic Requirements." The volume and classes of traffic are governing factors in the choice of the proper type of road. Traffic should be studied to ascertain these conditions before attempting to build. Great care should be given the sub-grade and the foundation, for the foundation in reality carries the load. In building the foundation careful attention should be given to drainage. If this is not done the bed becomes soggy and soft, with the result that heavy traffic is apt to break through the surfacing. Grades

Second Annual Conference on Road Construction for Road Superintendents and Engineers under the auspices of the Ontario Department of Public Works.—Group photograph of delegates bear an important relation to pavement; the destructive effect of heavy traffic on steep grades is a serious item. Also, damage is done to roads by horses' shoes and narrow tires; these may be remedied by the use of a flat rubber shoe for horses, and widening the tires in the case of vehicles. Again, the width of the street bears an important relation to the life of the pavement; if the street is narrow and traffic heavy it must necessarily congest, whereas if the street were wider the load would be more widely distributed. There are three general factors in the destruction of water-bound macadam roads—effect from horses' shoes and narrow tires, crushing effect of traffic, and the shear of fast, heavy motor trucks.

In choosing the type of pavement for a road the engineer should be given a free hand. There are, however, four facts to consider—traffic, character of foundation, existing grades, and the cost, both of construction and material. This latter factor often limits the type of road to be used; but along with it the factors of facility and durability must enter in.

For country roads for both rural and motor traffic Mr. Muir suggested a double road, with a 2-in. asphalt road in the centre, and concrete side roads for country traffic.

Discussion

Mr. W. A. McLean, in discussion, said: "There was a time when we thought we knew how to build roads, with only one type of traffic to consider; but the destructive effect of narrow tires has passed into insignificance; the destructive effect from shear of the fast auto and motor truck, in which the destructive effect upon pavement increases as the square of the speed, is a new and far more serious item. Ruts appear in the road, partly as a result of this, and to obviate this evil we shall have to restrict the load as well as the speed; educate the people to 'keep out of the rut,' and build our roads wider where traffic is heavier." A lengthy discussion, indulged in by several superintendents from the different counties, followed on "ruts," with the consensus of opinion that we will have to widen our stone surface in cases of heavy traffic and educate the people that the road is theirs, and they should help preserve it by driving all over the road.

* * *

GRADING

"Grading" was discussed by Mr. A. H. Parker, B.A.Sc. The sub-grade should be brought to the proper shape and alignment before commencing to place the surface material. In Ontario, roads follow certain lines, as laid out, irrespective of the topography of the country. With the location, which is the most permanent part of the road, arbitrarily fixed, the sub-grade or foundation, as the next most permanent factor, should be carefully built. In selecting the location of a road, it should have as low gradients and as direct a route as possible. By direct route, it may not necessarily mean a straight line, a horizontal curve is often shorter than a vertical one, as over a hill.

In Ontario many of our roads have grown up from pioneer conditions and are very crooked. These should be straightened. In building new roads the centre line of the road should coincide with the centre line of the road allowance. Avoid deep cuts, if possible; they are expensive to build and easily drift full of snow in the winter. In building side-hill roads, if the centre line of the road is brought to the grade level, when the road is widened out and finished, one-half will be cut and the other half fill. This provides a minimum of labor, and therefore cost. Ordinary dirt soil will stand up with an angle of repose of 1½ horizontal to 1 vertical. The slopes should be seeded to preserve, as well as beautify, them. Drag the earth from the ditches to the centre, remove all sod, because if used it decays and leaves a soft spot. If this is unavoidable it should be allowed to dry out, then bury two or three feet below the surface. Rolling the sub-grade before the surfacing is placed is very essential; it compacts the sub-grade and shows up any weaknesses.

Drainage, perhaps, is one of the most important things in road construction and upkeep. The sub-grade should, if possible, always be built up above the high-water mark. Build the crown in an arc of a circle, and make the ditches or drains follow the general water-course, being sure that they have an outlet and are not just allowed to become an elongated pond. In grading for a road it is important to study the location, keep as low grades as possible, use sound materials, provide good drainage, and build a good foundation sub-grade.

Discussion

Mr. W. A. McLean said that in the early days it had been hard to get a good alignment in grading, but a good deal of importance was placed on it now. The old idea of statute labor in road upkeep is passing out, and an organized system of county superintendents and road engineers is taking its place. More attention is being paid to drainage and its proper outlet.

Major Sheppard, of Welland County, spoke of the effects of water-soaked foundations, and the sudden changes in climatic conditions, especially in the winter season. Rapid rising and falling of the temperature causes disintegration of the road surface. If water-soaked, frost will heave the road up, and when the weather moderates it falls back, simply breaking it up. If proper drainage were instituted half our present road troubles would be eliminated.

An interesting discussion followed on the new Ditches and Water-courses Act, its application to specific cases, and how it should be interpreted.

* * *

THE ADMINISTRATION OF A COUNTY ROAD SYSTEM

This question was discussed by Mr. G. C. Parker, B. A. Sc. The success of a county road organization depends almost entirely on the knowledge and executive ability of the superintendent. This knowledge cannot be gained in a year and for this reason it is to the advantage of the municipality that the office of superintendent be retained by the same man year after year. Referring to specific details, the speaker suggested the early spring season as the best time of obtaining an accurate knowledge of local conditions. Much information can be gained at this time regarding the necessary drainage required. It is also the proper time to have machinery repaired. Sheds can also be built during the off season—preferably at a central point—for properly housing the machines. The grader is the first machine to be taken out in the spring, and should be used on all the roads. Simultaneously the drains should be attended to. Following the grader, the roller should be placed in operation just as soon as the ground is sufficiently dried out to support the load.

Importance was also laid on the necessity of having proper specifications drawn so that there may be no misunderstanding between the superintendent and the men in charge, or with the contractor. Where roads are built by contract the superintendent should have an inspector who will see that these specifications are carried out closely. Attention was drawn to the fact that municipalities do not appear to get as good results for the same amount of money expended as a private contractor will do, and it was urged that the policies followed by contractors should be more carefully studied. The contractor watches his costs carefully, replaces a machine which continually causes trouble by a better one, sifts out his poorest teams so as not to delay the others, keeps his horses well fed and groomed, and for the most part figures according to a unit cost system, so that from day to day he can place his finger on the leaks. There is no reason why the same principle should not govern the work in municipal organization.

* * *

THE USE OF OIL AS A DUST PREVENTIVE

Mr. Huber, Assoc. Mem. Canadian Society of Civil Engineers, addressed the Congress on the subject of Dust Prevention. He first outlined the causes of dust, which include the grinding and pulverizing action due to the impact of horses' feet and vehicle tires; the shearing action of self-propelled vehicle wheels; the physical actions of rain, frost and wind; the chemical actions set up in the weathering of stone; and—usually most important of all—internal attrition, or the grinding together of contiguous stones of which the surface crust is composed. Of all these agencies only the last-mentioned is preventable.

The lecturer outlined two methods by which dust may be prevented from rising, which he classified respectively as Cure and Prevention. The first was the application of such substances to the road surface as would hold down the dust already formed. The second was the employment of such methods and material in construction that the formation of dust would be practically prevented. The first method consisted in applying various liquids such as water, salt solutions, light oils, light tars, oil and tar emulsions, all of which gave only temporary relief. The use of granulated calcium chloride was also mentioned as being feasible in very moist climates only. It was pointed out, however, that in dust prevention very much depends on the condition of the road. First-class construction is the first and greatest essential. The application of oil to a thick coat of dust affords only temporary relief, and is expensive. The lecturer outlined the various methods of applying the different kinds of oil, and pointed to the necessity of observing certain rules very carefully.

The second method of treating roadways—resulting in dust prevention—consists in covering the entire surface with a carpet coat of heavy asphaltic oil or medium-grade tar, filled with stone chips free from dust. This results in a surface from one-eighth to one-half inch thick, composed of stone chips and a bituminous binder, the object of the stone being to take the wear of traffic and of the bitumen to bind the stone together and hold it on the road. This method is more expensive than the application of oils, but is usually more economical in the end, as an application will last several times as long. The lecturer outlined the proper methods of applying this carpet coat, and emphasized the importance of following instructions carefully so that best results may be obtained. The cost of the carpet coat as described is estimated at from eight to ten cents per square yard, and the life from two to five years. Including maintenance cost, the annual charge for this road should be from two to four cents per square yard.

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PAINTING AND MAINTAINING STEEL HIGHWAY BRIDGES

This subject was taken up by Mr. George Hogarth, O.L.S., Assoc. Mem. Canadian Society of Civil Engineers, Engineer of Highways for the Province of Ontario. Mr. Hogarth emphasized the importance of painting steel bridges as soon as they are erected, and of inspecting them carefully twice a year for abrasions or rust spots, which should be cleaned and repainted. He emphasized, also, the necessity of using fresh, bright steel in the erection of bridges, as where certain parts are rusted it is difficult to anticipate where the weakest spots will develop. Great emphasis was laid on the necessity of all rust, dirt and grease being thoroughly removed from the steel before the first coat of paint is applied. A new coat of paint should be given to any bridge structure every four or five years at least, not only for preservative reasons, but also on account of the improved appearance to the highway of which the bridge forms a part.

Mr. Hogarth discussed also the different classes of paint which are available at the present time for steel work, and instanced some tests made during the last ten years by the American Society for Testing Materials. These tests indicated that the best paint was composed of red lead and linseed oil, with the red lead in ample proportions. Where the bright color of this paint is considered objectionable, it may be darkened by the addition of lampblack. The speaker also warned the delegates of the necessity of watching the men carefully who had charge of the painting work. The proper cleaning of steel before the application of paint required both patience and muscle, which discouraged the average workman. It is well to pick out men of recognized skill and dependability and confine them to this particular work. The speaker illustrated his lecture with a number of samples of angle steel painted under varying conditions of cleanliness, and showed that the piece which was clean and new requires less paint, less time to apply it, and presented a much better appearance—to say nothing of the increased factor of safety and the number of years added to the life of the steel structure.

The second part of Mr. Hogarth's paper dealt with the maintenance and inspection of steel highway bridges. Many instances could be cited where inspection of a bridge has revealed a serious condition due to broken sections. For example, in many of the older structures, which were pin-connected, tension members composed of square rods with welded eyes were frequently used. Indifferent workmanship in forming the weld frequently created a weak spot which, after a few years of service, showed itself by the weld opening. Such weak points should be noted and necessary repairs made at once. Inspection should at least be semi-annual, and should result in every portion of the bridge—the handrail, the approaches, the river-channel, etc.—being brought under the careful observance of the inspector. Notice boards requiring traffic to slow down should be placed in a prominent position, and the printing kept legible. The bridge trusses should be inspected to see that they are still in line, and the chords examined for twists or deflections. The inspector should satisfy himself that all lateral bracing is taking its fair share of the stresses. All nuts should be tight and sound. The whole structure should be examined for cracks and corroding. All wooden debris that might result in fire, and so effect the bridge, should be removed to a safe distance. Careful attention should be given to the drainage of the bridge floor, and care should be taken that the drip through the drains does not strike any part of the steel work. A few dollars spent on maintenance will often prolong the life of the bridge many years, and so delay a greater capital expenditure. To this, of course, is also added additional safety to life and property.

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SPECIAL PROBLEMS IN DRAINAGE

"Special Problems in Drainage," by M. A. Kemp, B.Sc. The use of tile in side drains, cross drains and approaches often facilitates the removal of water from the surface and subsoil and will render seemingly undrainable parts of the road quite dry, and will often change a very poor road into a very good one. In early roads the subject of drainage was considered a luxury rather than a necessity.

Points to consider in placing good drainage are:—

1. Follow any water-courses, and use them as outlets.

2. Keep drains open, and at the proper grade to allow water to get away rapidly.

3. Provide an outlet for every drain.

4. Use culverts, where necessary.

5. Keep the road well crowned to turn the water off.

6. Dispose of the water in small quantities.

7. In case of deep ditches, use tile drains.

Under the new Ditches and Water-courses Act all county councils must properly provide drainage for county roads. In flat districts water lingers too long in the ditches, which softens the road surface. Swamp roads, due to mud and vegetable matter, have been specially hard to maintain. Drainage in swamp roads should not be attempted without draining the whole swamp. Near to towns, to obtain the proper slope, deep ditches are often necessary. These ditches should be tile drained to eliminate danger. It is not advisable generally to drain sand roads. They should generally be left in a concave surface condition to hold the moisture as long as possible, being in a much better condition wet than dry. The usual place for tile drains is on each side of the road, with V-shaped drains from the centre to the road-side. Tiles not less than 4 ins. in diameter should be used. Clay roads need much more draining than ordinary soils. Tile drains in clay roads at first do not always give best satisfaction, but it is generally considered that this increases with age. In a properly drained road even frost will leave the road surface alone. The destructive effect of frost is directly due to the moisture contained in the road surface or subgrade. Where quicksand and soft soggy foundations are met with, they should be always tile-drained, with a good outlet if possible. If not, straw and sawdust should be placed around the drain, or even boards used to lay the drain on.

The essential feature of good roads is drainage—better drainage—the best drainage possible—and keep the drains in the best condition

Discussion

Mr. McLean: Too often the work is considered finished when a drain is laid. This should not be. They should be inspected regularly to see that they are in proper condition, and that they are doing all that is required of them. This is one of the advantages of a county road superintendent, who can continually inspect them. In heavy clay soil, where an outlet does not seem at once available, relief may often be obtained by drilling through the clay and obtaining an outlet in a gravel or sand layer below the clay bed. This is not always practicable, but is often done. In counties where there is considerable rock and stone a permanent ditch should be blasted along each side of the road by the use of machinery.

Mr. Young: A systematic upkeep of roads will be very much more easily obtained by a good system of drainage. Especially on hills, drains are found to be very satisfactory. Too much attention cannot be paid to securing proper outlets for these drains, as drainage seems to be the foundation of a good roads system.

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ROAD LAWS

Mr. W. A. McLean, Mem. C. S. C. E., Deputy Minister of the Department of Highways for the Province of Ontario, with a view to interpreting to the county road superintendents more clearly the highway statutes, delivered an address on "Road Laws"; the legislation under which the Provincial Government extends aid to municipalities for road improvements and the statutes upon which municipal organization for road purposes is based, should be clearly understood by all road superintendents and highway engineers. Road laws have been simply a matter of evolution; as requirements demanded they have been amended and revised to fit the condition of existing affairs. One of the first statutes passed in Ontario legislation, in 1793, was that respecting statute labor on roads. This is an old system, having been used in the United States and Great Britain. It has done a lot of good, can still under good organization do a lot of good, but it is giving place to a system for good roads, properly organized and maintained, by municipalities with the aid of the Government.

Roads should be constructed according to the traffic to be carried over them, should be paid for according to construction, and assessments made in proportion to the benefit derived.

There are three general sub-divisions of roads—main highways, market roads and township roads. Along the main highways, which extend from towns to cities, in the earlier pioneer days the settlers built their homes and farms. One of these main highways is the old road from Detroit, through Windsor, Chatham, Woodstock, Ingersoll, Brantford, Hamilton, Toronto, Belleville, Kingston, Prescott, etc., to Montreal, and along this old highway or within twelve miles of it is half the population of Ontario. At right angles to these roads are the market roads, which are essentially the heart lines of the municipality. From these market roads branch off the township lines. These latter roads carry very little traffic. The main roads, comprising only 18 per cent. of the total roads, carry 78 per cent. of the total traffic.

It is planned to place the main and market roads under a separate organization and to institute a good maintenance system. Small farm side roads will still be left in the hands of the township authorities. The counties will be expected to take over the market roads and the main roads and will be encouraged to improve and maintain them. There are some main roads, such as the Toronto-Hamilton Highway, which will be placed under separate control.

The principle that cities shall pay their share in the cost of highway construction and maintenance ought to be inaugurated. Unfortunately, when a city is incorporated it is isolated from the county, as a separate unit, and is not assessed by the county. In the United States and Great Britain this is not the case. There they remain in the county and are assessed for a county tax. The result is that in paying for concrete highways the cities, which use them to a great extent, pay as high as 85 per cent. of the cost of construction. In Ontario this is not so. Some means has to be arrived at whereby the cities shall pay their just share.

The plan proposed is to adopt a suburban area around the cities. The roads in these suburban areas will be county roads constructed by the county. The city council will appoint a commissioner and the county council one, and they in turn select a third. Their first duty is to study the situation with respect to how far out on the highway the city shall pay for construction and maintenance and to determine the expenditure or first cost and maintenance. When this report is received and amended and adopted, both city and county subscribe equally. That is, as a county road the Provincial Government grants 40 per cent., the city and county each then paying 30 per cent. of the cost—with a provision that the tax on the city shall not exceed one-half mill in any one year. This provision in a way determines the mileage to be constructed per year.

This in general constitutes the features of the Ontario Highways Act, passed last session. It also provides for main roads, however. The province pays 20 per cent. of the maintenance cost of county roads. Also, where any township provides a permanent overseer, the province pays 25 per cent. of his salary for the first three years. The department is urging the township to employ such men. He should be as essential to the township as the clerk. This time will come, but the public will have to be educated to it.

All the statutes on roads and road laws have been compiled in a separate volume for the convenient use of the superintendents and engineers. The difficulty of getting laws made to cover what is wanted, and nothing more, is very evident.

The department especially desire that the road superintendents and engineers in compiling their reports for the department will make them as clear, concise and accurate as possible. In last session's sitting we had an amendment to the Highways Act passed which gives county superintendents power to act practically as owners of the highways.

Discussion

Mr. Bowman: "Our congratulations are due Mr. McLean for the splendid work he has done. We are pleased to know that he has been gazetted as Deputy Minister to the new Highways Branch. We have now a very good system of road laws, and all counties should take hold and make themselves available of the Government Grant." Mr. Bowman spoke on the new suburban roads and stated that they were trying to avail themselves of the new law to lay a concrete road from Galt to Preston.

Mr. Fair suggested having each farmer looking after his own section of road and promoting competition to secure best results.

The subject of "farm approaches" drew forth a lot of discussion as to who should put them in. It was generally agreed that the municipality should take care of everything between two fences—put in approaches and charge the farmer with them. If left to the farmer he does not always understand the business properly and is apt to do poor work.

The question of having the city pay some share in the maintenance was also fully discussed. It was felt that the city, either directly or indirectly, profited by the highways, and as representing a large population located at some point on it, they should in some way contribute.

Mr. Fair suggested placing the auto fees in a separate fund for special work. Mr. McLean stated, however, that the auto department is to be incorporated in the Highways Department and the fees will go directly to the road. The Toronto-Hamilton Highway was the next subject. The province is only paying 25 per cent. of this road, which is not so much as it pays for county road construction.

Mr. Talbot introduced a discussion on the division of repair and construction of roads and the Government subsidy in each case. In the case of repair the Government pays 20 per cent., in new construction 40 per cent. Mr. Talbot spoke of the trouble in discriminating between these, and thought that an average of 33 1/3 per cent. would be better. Mr. McLean, however, considered while it would be hard to draw a hard and fast line between them, he didn't think it would give any considerable trouble if the law were judiciously administered.

Closing Roads Under Repair

Mr. Russ introduced the question of closing roads to traffic while under construction or repair. While the superintendents have no real power to do so they should use their good judgment in regard to eliminating trouble from damages during repair.

Mr. Anderson: The subject is one not very clearly defined by the statutes, and we ought to have some protection for ourselves while the construction machinery is on the road.

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BITUMINOUS ROAD CONSTRUCTION

There is a growing tendency in Ontario towards the use of bituminous roads—that is, roads in which tar, asphalt or asphaltic oils are used as a binder for stone, gravel, sand and slag—or as a protective coating in forming the wearing surface. Mr. Muir, in his paper on "Bituminous Road Construction," dealt with the special features of a number of types of bituminous construction. In recent years the advent of the automobile and heavy traffic has evolved new types of road construction.

Methods of using bituminous materials may be classified as follows: (1) Penetration method; (2) Mixing method; (3) Carpet coats. In the first method broken stone passing a 2 1/3 in. ring and retained by a 1½ in. ring is spread evenly over the ground about 4 inches thick and rolled to an even surface. Into this heated bitumen is poured in best manner available, using about 1¾ gals. of bitumen per square yard. Over this a light layer of stone chips is spread, and the surface thoroughly consolidated by a steam roller. There are a number of methods for pouring or placing the bitumen on for this process—hand sprinkling, gravity sprinkling and pressure sprinkling. For best results the bituminous material should be heated to properly penetrate the surface.

The second method is a surface made by the mixing method, and called "asphaltic concrete." This system is well adapted for improving old macadam roads; it is more expensive than the penetration method, but is also more durable and desirable, and will support heavier traffic. Over a layer of broken stone is first sprinkled a light coat of tar as a binder coat to unite the surface to the foundation. On this is spread a layer of stone with which hot asphalt or tar has been previously mixed, generally in a plant on the roadside, in about the proportion of 15 gals. tar to 1 cu. yd. of stone. This coat is spread and rolled to a depth of 2 to 3 inches, then treated with a layer of stone chips to dry the surface and again rolled. The materials should be uniformly proportioned, using the various sizes of fine stuff, sand, stone and bitumen in carefully and evenly graded quantities. The asphalt or tar should be heated to a uniform temperature, care being taken that it is not over-heated.

In the third method the "carpet coat," as the name implies, consists of a thin layer of asphaltic materials spread over the surface of a broken stone road. Asphaltic oil, a fluxed asphalt, or a suitably fluxed tar are the materials generally used. The road surface, before application, for best results, should be smooth, free from ruts or holes, and thoroughly cleaned to allow maximum adhesion. If the oil used is very heavy and contains a high percentage of bitumen it is best to coat it with stone chips or pea gravel to prevent stickiness and give a better wearing quality to the coat. This construction protects the surface of the road from wear and effectively prevents dust.

Discussion

Bituminous construction has up to the present been more especially adopted in the vicinity of Toronto but is now becoming more popular in other vicinities. In Waterloo, according to Mr. Bowman, on certain heavily travelled roads, the tendency is towards concrete roads or concrete subsurface, with a bituminous surface coat. Mr. Bowman also thinks that for highways near towns or cities, with heavy traffic, waterbound macadam has served its day. The future roads have got to be cheap and easily maintained. In this respect concrete, while it has a high initial cost, costs practically nothing for maintenance.

* * *

CARE OF EARTH ROADS AND USE OF LOG DRAG

Due to the fact that eighty per cent. of our country roads are dirt roads, the great necessity of keeping them properly maintained is very essential. Mr. W. H. Losee, B.Sc., in a paper on "The Care of Earth Roads and the Use of the Log Drag," pointed out the good results that can be obtained by the systematic use of the drag on earth roads.

The grade, or crown, of the road depends a great deal on the character of the soil. If it is heavy clay the crown should be relatively high; if sand, it should even be inverted to retain the moisture. But in all roads except sand, they should be crowned and adequately drained. Clay roads may be improved by the use of sand, and vice versa, by a thorough mixing of the materials and dragging to a good crown.

Great care should, however, be exercised in the time of dragging. The best time is generally immediately after a rain, when the earth will work well, yet not cake. Clay should be fairly sloppy, to prevent sticking. Or again, in real dry weather just before a rain the soil is easily placed wherever required. Good results can be obtained by dragging as early in the spring as possible, and again, as near as possible before the frost sets in. Dragging should be done systematically, never trying to increase the mileage at the expense of the quality of the work. Organize the farmers to do their own section and stimulate competition for best results.

Discussion

An exchange of ideas and methods used in dragging in the different counties followed. General opinion was that it produces the best of results, but is not sufficiently used in the townships. New roads are often necessary because of the neglect to properly grade and maintain earth roads to make them passable the year round. The relative merits of the split log and the steel drag were also discussed. The steel drag may accomplish more work but it requires ever so much more power and in general is rather more cumbersome to handle—wonderful results can be accomplished by the systematic use of a light split log drag on earth roads.

Good Roads as Monuments

During the Thursday morning session Mr. G. S. Hendry, secretary of the Ontario Good Roads Association, and Mr. K. W. McKay, expressed views in regard to organizing and establishing a monument to our returned soldiers, in the way of an improved system of highways in Ontario. Their idea was to employ returned soldiers on highway improvement and in so doing to improve both the soldiers' conditions and those of the province; to designate such improved highways by names now before the world's eye, in commemoration of the work done by our Canadian soldiers.

* * *

STONE FOR VARIOUS KINDS OF ROADS

With the rapid developments in highway engineering the growing demand for permanent construction, and the increasing severity in conditions that our roads are required to withstand, a careful choice of materials is demanded. The careful selection of materials is of equal importance to careful methods of construction if best results are to be obtained. This was pointed out by Mr. G. C. Parker, in his paper on "Stone for Various Types of Roads."

The foundation of the road is required to withstand the weight of the traffic and the action of the frost, while the top or surface coat is required to meet more severe and more varied conditions. Wear is caused by abrasion of steel tires on a smooth surface and impact on an uneven surface, impact of horses' feet cause a dislodgement of stones or breaks them, while the dislodgement of stones and the effect of shear by auto traffic is serious. During dry weather the rubber tire flattens out as it comes in contact with the road surface and on leaving it picks up the dry binder from between the stones and the strong current of air, ever present under a swiftly moving vehicle, carries it away in the form of dust. In order to efficiently resist these effects the stone or rock must be tough and the binder sufficiently strong so that the road will not go to pieces quickly.

If the road becomes impregnated with water the stone, as well as the binder, absorbs an amount of water and if frost falls it must be exceedingly tough to withstand the frost action. The binder is more elastic and is not so subject to frost. Trap rock and limestone are the most universally used stone in Ontario, the latter being the more so.

That the probable behavior of a road material on the road can be largely determined, tests of its physical properties are being watched more fully every day. In testing stone the following properties are determined: wearing qualities, toughness, cementing value, absorption and specific gravity. These tests have been conducted under the direction of Mr. McLean and the equipment and methods used are almost identical with those at Washington, D. C. The apparatus was here shown on the screen and explained.

The power of withstanding the destructive agency of climatic conditions is an essential factor in the choice of stone to be used. Some rocks might give good results in all the laboratory tests, but not be able to withstand the weathering action. This is an important point in choosing surface material and can only be decided by experience often. The size of the stone and relation to the voids is another essential condition. Some engineers specify one size and some another, but the general size adopted is 2 in. stone, that is, stone passing a 2½ in. circular opening and retained by a 1½ in. opening; such stone to have good binding qualities, key well, and leave as small a per cent. of voids as possible. The stone should carry the load, the cementing material being present only as a binder.

Discussion

In reviewing the paper Mr. McLean pointed out the importance of it to the superintendents of the different counties. Most counties have their own stone; a few have to import it. It would therefore be wise for the superintendents and engineers to know something of the stone they are using, or are contemplating buying. In concrete work, too much stress cannot be placed on the importance of testing sand and bank-run gravel in concrete work. Numerous failures can be traced to poor grades of sand being used. Engineers found the item of cost a big factor in choosing the stone. Supplies may often be had near the site of proposed work, which were not so good as samples miles away, but the item of cost and earlier renewal favored the closer quarry. The binding qualities of stone from several different quarries formed the basis of a good discussion. In general the first cost only comes once, while maintenance is, or should be, always with you; it would pay, therefore, to use a good quality of material, probably slightly increase first cost, but considerably reduce the maintenance cost.

Mr. J. F. Whitman, engineer in charge of trunk line construction in Northern Ontario, gave a brief talk on the rock and methods used in building and maintaining roads in Northern Ontario around Sault Ste. Marie.

* * *

TORONTO-HAMILTON HIGHWAY

"Construction Methods on the Toronto-Hamilton Highway," by Mr. H. S. Van Scoyoc, chief engineer Toronto-Hamilton Highway Commission, was an illustrated lecture, both by slides and moving pictures, on the methods of handling and placing the materials on this large piece of construction work which is of such great interest to all road builders and engineers. A full description of this work appeared in the Contract Record of January 5. After the talk Mr. Van Scoyoc answered numerous questions put to him by various superintendents.

On this work, all materials, both sand and stone, were inspected in the pits and quarries before being shipped to site. Sand strong in quartz and silicate was desired, but most sand in that locality was limestone. No gravel was used, as it was not commercially feasible as compared with broken stone and sand. All cement was required to be in the mixer at least 45 seconds. The maximum advance was 630 feet in twelve hours with an average of 420 feet in ten hours.

* * *

THE CARE AND OPERATION OF QUARRYING AND CRUSHING EQUIPMENT

Mr. R. M. Smith, B.Sc., dealt with the care of modern portable quarrying and crushing outfits and the manufacture of road material for county roads.

The first operation in opening a new quarry is the stripping. This factor varies with the nature of the site, and is often eliminated where the rock is exposed, but as a rule costs about 25 to 30 cents per cubic yard to remove. Always some surface material should be removed, even if it is stone, because better quality always exists lower down. With the stone exposed the machinery may be erected. Crushers are either jaw or gyratory type, the former being most used in Ontario. The location of the crusher is one of the fundamental factors in efficient operation. If the crusher can be placed below the quarry face, the material can be transported by gravity and dumped into the hopper, thus eliminating extra handling, which, in the case of a large quarry, would be no small item. Always work down hill, never up, if it can be avoided. It is well to emphasize setting the crusher on timbers, making it absolutely rigid. A crusher allowed to operate standing on the wheels is being hurried to the scrap heap.

The shape, size, and composition of the crusher jaws are the chief factors to consider in a good crusher. Manganese jaws are preferable—they cost much more than ordinary jaws, but they will outwear several sets of the latter, and require practically no attention. Jaws approximately 12 x 16 to 10 x 18 have been considered the correct size.

From the crusher, stone is carried to screens by bucket elevators. These screens demand consideration and attention. For limestone they contain two sizes, 1¼ in. and 3 in., and for trap rock are somewhat smaller, approximately 1 in. and 2½ in. The storage bin should have ample capacity with traps for loading stone into wagons. Often stone in a limestone quarry can be removed with little or no blasting; then the rock becoming firmer requires powder or dynamite to remove it. Drilling may be done by hand, steam or compressed air, with the former two the most common, but being slowly replaced by the latter. The cost per foot of hole drilled by the hand method is 35 to 45 cents and by mechanical means 15 to 20 cents for 1⅛ in. and 1¼ in. drills.

Mechanical drills should be operated by capable men—experience means efficiency. Great attention should be paid in steam drilling to the apparatus. In setting a drill great care should be taken to level the rock so that the steel will strike square. When starting a hole, short light blows should be used, the strokes being gradually increased. Drills should be changed approximately every 15 ins., depending on the hardness of the rock. The operating pressure on the drills in the mechanical process is approximately

80 to 90 lbs. per square inch. Steam or air is not only cheaper than hand but saves considerable man power, and work is carried on at a faster rate. The explosive used to break the rock which seems to give the most satisfaction is gunpowder or low freezing dynamite. A mild explosive causes fewer small fractures and therefore prolongs the life of the road.

Stone is generally moved from the quarry face to the crusher either by dump cart, hoist or the old fashioned wheelbarrow. The hoist is probably the most efficient, but in most portable outfits this does not exist, and dump carts or wagons take its place. Of the latter two the dump cart is certainly to be preferred. One horse will do the work of a team. Two or three dump carts at most can keep a crusher busy; they are handy to handle in the quarry, quick to unload, no time being lost at the crusher platform, and generally more efficient than any other method of moving material, except probably in the case of the gravity methods, previously explained. The crusher should be run to full capacity at all times; the efficiency of the outfit and the speed of road building depend upon the crusher, which, as a result, demands the greatest attention.

In some counties large quantities of field stone and gravel exist, which, when crushed, make a very good road material, the only objection being its lack of uniformity. The life of a quarrying and crushing outfit depends partly on the local conditions, but principally on the kind of material it has to handle. Regardless of the kind of material, a crusher will depreciate rapidly if not properly handled; good management will practically double its life.

Discussion

Mr. Talbot and Mr. Fair described their respective outfits, illustrating with interesting lantern slides.

Mr. McLean in reviewing: Some counties have an efficient supply of stone, but do not use the crusher as much as they should. If the counties would use larger crushers they would be able to get satisfactory financial returns out of the stone, the trouble often being that they use too small a crusher. Speed in road construction depends on keeping the crusher going. Keep it in good repair, even at the expense of keeping the engineer after hours to fix it up.

Mr. Wilson described the outfits used in Halton County, and gave some figures on cost and output. The discussion pointed towards lower cost by contracting the quarries than operating them.

Major Sheppard was of the opinion that the personnel of the foremen had a great deal to do with the daily output, records showing that one man would double the output of another from the same quarry.

Mr. Fair: The variation in the work of manufacture of road material demands a man of good insight, and well able to handle men. Such a man, if he can be got, should be paid such wages as will keep him permanently.

Mr. Sheppard: What do you consider good pay for a foreman?

Mr. Fair: $3.50.

Mr. McClure wanted to know the relative merits in size of openings and length of jaws. Finds a tendency for some stone to fly out of the crusher.

Mr. Smith: The common sizes are 12 x 16 and 10 x 18, the former being the most common.

Mr. Anderson, of Lennox and Addington, who has had considerable experience, places extreme importance on the shape of the jaws, using a jaw somewhat concave so it would grip the stone on closing. Some discussion followed on crushing field stone and the cost of opening quarries. In Prince Edward, according to Mr. Cleminson, due to depth of rock below surface, it costs approximately $300 to open a quarry.

* * *

RESURFACING GRAVEL AND STONE ROADS

Mr. A. S. Smith, in his paper on "Resurfacing Gravel and Stone Roads," gave various methods which may be used, each dependent on the degree of wear which the surface has attained. Gravel comprises 75 per cent. of the improved new road construction. In designing a new road, the nature and extent of the traffic must be known; these are determining factors in the width and depth of the construction. Another important factor is the proximity of material—which is the most economical to use.

In early gravel road construction it was customary to dump on any kind of gravel, of any size available, and leave it to take care of itself. It was not rolled, and soon rutted; being soft, it absorbed a large amount of water, and was invariably in time forced out, to the extent of at least 25 per cent., into the ditch. Now, with the advance of knowledge in this respect, it could be done properly. When resurfacing, it is also a good time to correct defective grades, and place permanent culverts.

The proper method of resurfacing is to clean the road surface of foreign matter, break up the surface to a predetermined depth by the use of spikes in the roller, or by a scarifier, bring to proper crown by the use of the grader, add new material, and carefully consolidate with the roller. The use of the scarifier or spikes effects a very good bond between new and old materials. Clean sharp pit gravel should be used, 60 per cent. of which will pass a ⅛-inch screen. Round beach, pebble gravel should not be used, because of its low binding qualities. Great care should be given to rolling, starting at the sides, and working to the centre. Work from the pit away in order that traffic may help consolidate the surface.

In resurfacing stone roads the nature of the traffic will again determine the type of the material for resurfacing, the extent of the thickness of the coat and the size of the stone. For heavy traffic, hard, tough stone with good weather-resisting qualities, from 1½ to 3 inches, is the best size. Loosen the old surface, grade, and add new stone in coats, rolling each coat well. When the top coat is so consolidated that the stone does not move under the roller, apply the dust coat and water, in proper proportions, and roll into the voids. Brooms can be used to good effect. Another method is to clean the old road, fill the ruts first, then place the stone in the same manner, the difference being that the scarifier is not used to effect the bond.

In dry weather, water-bound macadam is apt to be dusty—traffic loosening the dust—which blows away, leaving the stone exposed. This can be greatly remedied by the application of oils or tars.

Discussion

Mr. McLean: In some counties, construction is the important item; in others, reconstruction. Some counties have been favored with plenty of material and have made good progress in highway improvement. Others, less fortunate, have stood still.

Mr. Fair, of Frontenac, did not consider the use of the scarifier good policy. In Frontenac the majority of roads are old stone roads—some very old, with comparatively good foundations—and it was not considered wise to destroy such foundation by the use of the scarifier. Good bonding results were obtained by filling into and placing a new coat. Material for resurfacing is very plentiful in Frontenac; in one case a mile and a quarter of stone road was resurfaced 10 to 14 inches thick. The scarifier, however, was used to good effect on hills, and side ditches, in repairing them.

Mr. Russ advocated the use of the roller with short spikes, which, while it did not disturb the foundation, broke up the surface sufficiently to effect a good bond.

Mr. Wheelock, of Orangeville, said the trouble is roads do not wear even, and it is very difficult to get a good bond. Thinks the use of the scarifier gives good results. He also asked the opinion of the conference on the use of clay with gravel as a binder, his own experience being that in wet weather it was muddy, and in dry it dusted and flew away. This seemed to be the consensus of opinion.

Mr. McLean: If only going to repair the road by adding a 2-in. or 3-in. coat, break up the surface, but if 7 ins. or 8 ins. is to be added, do not disturb it.

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CONCRETE BRIDGES

"Concrete Bridges, Culverts and Floors," by Mr. Arthur Sedgwick. Efficient construction will effect a great saving in the cost of all concrete work. The adaptability of concrete to the construction of culverts and short-span bridges is due to its permanency, simplicity of construction, and general availability and reasonableness of cost. Portland cement concrete is probably the most durable building material known to-day, a condition which is only realized, however, if the aggregates are properly mixed and the structure properly designed and constructed. Ignorance and lack of experience in the past has led to bridges only lasting a portion of the time they were normally capable of. This condition ought not to exist to-day; mechanical skill of a high order is not necessary to design or construct a concrete structure, the form work is not difficult, neither are the precautions in mixing or laying the concrete. Yet unless the work is carried out under men experienced in it the results are often jeopardized.

The time has arrived in Ontario when we should expect our local public works to be constructed with a neater and more finished appearance. In cities and towns works are usually built to show a degree of refinement and finished design. This should be equally true of highway structures. The causes for poor outward appearance of so many of our bridges generally are: (1) lack of sympathy on the part of the community for something better; (2) failure on the part of the engineer or road superintendent to enforce the specifications; (3) lack of efficient inspection; (4) incompetence on the part of the contractor or foreman. Some of the common defects in country structures are: the structure is placed off the centre line of the road, or not in line with it, broken corners and edges, distorted walls due to forms being loosely built and insecurely braced, trying to improve porous surfaces by the injudicious use of plaster. In addition to these unsightly effects, the following defects in methods and results which lead to a materially weakened structure as well as an unsightly one: the injudicious use of pit gravel, insufficient and poorly mixed cement, poorly supported forms, which allow the concrete to settle in setting and misplacement of steel reinforcement. To avoid these defects, a brilliant mind is not necessary, but they do require attention by a thoroughly experienced and common-sense foreman.

Wherever possible the forms should all be built and braced before laying any concrete. Many culverts and some bridges are spoiled or endangered by not having the foundation footings carried down deep enough. In sandy soils particularly, there is a danger of water undermining the structure. In spite of these the construction of a culvert should be an easy matter. In point of efficiency the built-on-the-field culvert is far superior to the ready-made variety. As compared to the circular section, a square or rectangular section has relatively higher water-carrying capacity at any height of water.

With the advent of the new and increased traffic, culverts and bridges should be built wide enough to accommodate future development. Small culverts up to six or eight feet in diameter should be built to allow for not less than a 24-ft. roadway. The increasing occurrence of accidents from motors colliding with handrails on narrow culverts makes it essential that in future they be built to the width mentioned.

The present practice of placing floors in steel highway bridges is to lay the stringers on top of the floor beams, uniting them lightly to the top flange; placing the concrete floor slab on these and relying on them to hold the stringers together and prevent toppling due to lateral forces and vibrations. The increased use of the motor truck will necessarily put much severer strains on the bridges and for future construction it is considered advisable to rivet the stringers to the webs of the floor-beams as is done in railway and building construction; also to extend the concrete floor half an inch below the top flange of the stringers in order to stiffen them against lateral deflection and movement.

Mr. Sedgewick pointed out, by the use of slides, some examples of different defects and results of defective construction, besides showing a number of interesting views of concrete bridges and culverts.

Discussion

Mr. Bleaker: We are having trouble with our concrete floors rutting. What is the cause, and how can they be remedied? One bridge is 300 feet long, has heavy narrow tire traffic, and has been down five years.

Mr. Sedgwick: If it has rutted in five years, it was poor concrete.

Mr. Connor: It is just a question, if it has rutted, whether it should not all come off and be resurfaced; it is apt to break through any time. I have patched concrete floor ruts by the use of a rich cement plaster with a mixture of iron filings to give it good building qualities.

Mr. McLean: Have you had any experience with creosoted wood blocks? It might be resurfaced with them without increasing the load on the bridge enough to render it unsafe.

Mr. Wheelock: We find the use of creosoted wood block on creosoted planks and stringers very expensive, an 18-ft. by 70-ft. bridge costing $1,400. It may give a good long wearing surface if properly sanded, but it does not increase the strength of the floor. If a floor ruts, take it up and resurface it—it is the best way and probably the cheapest.

Mr. Talbot described some experiences on placing concrete, in both excessively hot and cold weather. In one case the concrete became baked before setting, and under traffic ground out. Concrete can be laid in the coldest of weather if not allowed to alternate between high and low temperatures, which disintegrates it.

Mr. Connor pointed out the necessity of the proper placing of reinforcing steel in concrete. The proportion of the depth of the reinforcement to the depth of the member has a definite bearing on the strength of the structure.

* * *

THE OPERATION AND CARE OF THE ROAD ROLLER

This topic was covered by Mr. W. Huber, Assoc. Mem. Can. Soc. C. E.: The quality and amount of work produced by a road-building outfit depends on the efficiency with which the roller is operated. While the introduction of the grader and rock crusher have reduced the time and cost of road construction, it cannot be said that they have greatly raised the quality of the work on macadam roads above that as practised by McAdam. It remained for the self-propelled road rollers to accomplish this. Just to what extent the quality of the finished road will be improved depends largely on the manner in which the roller is operated.

To secure a properly crowned surface of crushed stone so compacted that further consolidation by traffic is impossible, a surface bound with stone dust or screenings filling all interstices so as to prevent movement of the stone, and the whole cemented together in a solid mass capable of distributing the weight of traffic over considerable area of sub-grade—it is necessary to consider methods of securing a maximum consolidation of stone with the least expenditure of time and labor.

It must not be expected that satisfactory consolidation can be expected where the sub-grade is not itself solid. Consolidation by a roller is due to its weight alone—high speed is detrimental due to the thrust of the roller. To secure rapid consolidation the stone at the side should be confined to prevent spreading.

Never roll too thick a layer at once; better results are got by doing it in thinner layers more often. Always commence rolling at the side and gradually work towards the centre; by rolling the sides first side movement is prevented and the crown maintained.

Rolling should continue until the stone under the roller shows no movement. Consolidation may be hastened by a light sprinkling of water. Best results will be obtained in rolling the road in sections of definite length, being sure to thoroughly finish one section before moving on. When the stone has been thoroughly consolidated, and not till then, the screenings may be applied. The application of screenings is almost an art, and has much to do with the success of the roadbed. Thoroughly wet the screenings before rolling of the binder coat is commenced.

On his skill and attention to details by the operator depends the success of the finished road. He should be a man of intelligence and good judgment, and a student of his work, for his greatest source of knowledge will be his own experience:

Discussion

Mr. McLean: County superintendents will save themselves a great deal of trouble by properly educating the roller operator, in whose hands rests the success or failure of the road.

Mr. Wilson stated that enough attention has not been paid to rolling. He gave a description of rolling operations in his own county of Halton.

A lively discussion took place on the relative merits of steam and gas rollers. The gas roller, if properly operated and maintained, claims distinctive advantages over the steam roller—the necessity of getting up steam in the morning, stopping for fuel and water, etc., are overcome; but it was felt that the average operator did not as yet know enough about gas engines to operate them properly.

* * *

MAPS AND PLANS

"Maps and Plans," by Mr. T. M. DeBlois, S. B., Assoc. Mem. Can. Soc. C. E. Good maps are necessary to systematic road development. The Department is constantly preparing maps of counties and townships, copies of which are available for the use of county road superintendents and engineers. They are a source of information on county roads, which can be easily and quickly referred to for information. It is proposed to have a standard legend for the different constructions, kinds of roads, bridges, culverts, gravel pits, and quarries, all marked on the map. The superintendents are urged to co-operate with the Department in the use of maps, in correcting errors, and notifying the Department of any changes made. They should be of special use to the superintendents in studying the profile of county roads, in determining the amount of cut and fill necessary in building a proposed road, estimating the grades, and from these the cost of the construction.

Discussion

Mr. McLean pointed out the necessity of co-operation between the superintendents and the Department in the use of maps. He also considered a course of instruction in the use of field instruments would be very beneficial to the superintendents in affording them a better knowledge of road profiles and drainage slopes, and in aiding them in laying out new roads. Mr. Wheelock agreed with Mr. McLean in regard to the use of instruments and the aid of maps and plans in studying a location for estimates before starting the construction of a road.

Mr. McLean, in reviewing the conference, and the subjects discussed, asked the members to notify his department if there was any problem or subject they would like discussed next year. At present about half of the counties were working under the provisions of the Act, and it is expected that before long all counties would be included. The Department have tried to make the papers as practical as possible, but it is often hard to discriminate between theoretical and practical. The theory of to-day will be the practice of tomorrow.

Mr. Fair requested a paper on Sand Clay Roads and the cheapest and best means of improving sand roads.

Mr. Talbot suggested a discussion on the working of the Compensation Act in regard to the municipalities.

Mr. Elison—With the increased traffic on country roads something has got to be done with country bridges. Would like to see the Department send out engineers to inspect all bridges, and where necessary have new ones built.

Mr. McClure would like to hear something about snow fences, and the law in regard to placing them.

Mr. Young, on behalf of the superintendents present, moved a vote of thanks to Mr. McLean and his staff for the splendid work they have done in assist-

(Concluded on page 160)

The Kaministiquia Power Company

Rapid development of Canadian Twin Cities Due Largely to Ample Supply of Dependable Power — Latest Installation Work at Kakabeka Falls

By P. R. Farrow*

Penstock Gates

Two heavy wooden flap gates, built of 10 in. x 10 in. timbers, having proved unsatisfactory owing to their great weight and difficulty in handling, a set of five steel gates, with 10-ft. diameter openings, were installed in front of the bellmouths leading to each penstock, each of which supplies its own generating unit with water through an iron pipe.

These gates, with their operating mechanism, weigh just over twenty tons each, and were supplied by Messrs. J. M. Voith, and erected under the supervision of their mechanic. The heaviest part of the shipment weighed 7½ tons and consisted of the 10-ft. diameter gate, which was shipped in one piece. The outer casing, in four parts, was bolted together in place and concreted solidly into the walls of the building and fastened with bolts into the vertical wall. Owing to the outbreak of the European war the operating mechanism was not received and temporary expedients have been adopted to open and close the gates.

It was the intention that the gates when normally open might be closed by an operator in the power house pressing a button or by an excessive increase in the velocity of water in the penstock. A storage battery placed near the forebay, in a specially designed house, supplies current to an electric motor mechanically connected to each gate. Switching equipment automatically starts the motor for closing the gate only when required; a clutch and a handwheel serves to open the gates. An attendant is necessary to fill the pipes in order to provide against over rapid filling for the penstocks.

* Power House Superintendent.

Penstock No. 4

The dimensions of this steel pipe are: length 740 feet, diameter 11 ft., thickness of top plates ⅜ in., thickness of bottom plates 13/16 in. Two 7 ft. 6 in. diameter bellmouth pipes from the forebay wall, feed into the common 11 ft. diameter pipe about 60 ft. from the forebay. The pipe then slopes at 23 degrees for 250 feet and changes to a slope of 9 degrees for 125 ft. and then forms a curve on a 262-ft. radius, 365 feet long, with large concrete bulkheads at each end to prevent movement. A sharp slope and a bend brings it to a nine-foot diameter butterfly valve which terminates the penstock. A drain discharges the water into the power house tail race, when it becomes necessary to empty the pipe. The joints in the steel work consist of double riveted lap joints near the forebay, gradually changing to triple-riveted butt joints at the power house.

From the forebay to the commencement of the curve the pipe is carried on concrete saddles placed about 25 feet apart and two feet wide. Around the curve steel saddles are used, resting upon a steel base so that expansion or contraction may be absorbed by changes in the length of the curve.

Cover.—Over the penstock a concrete cover has been built with a clearance of 18 ins. between the pipe and steel work. Angle iron ribs, curved to radius and projecting into a light concrete wall foundation are spaced three feet apart by iron bars punched and riveted to them. These bars in turn serve to hold poultry netting and tar paper which forms a backing for the 1½-in. thick concrete cover-

Interior of Power House showing 2 exciters, 3-5,000 h.p. direct connected units, and new 12,500 h.p. unit in background—Operating room to left, transformer gallery in foreground.

General View of the Kaministiquia Power Company's Hydro-electric Station at Kakabeka Falls Shows Forebay and Spillway

ing, which was reinforced with triangle mesh wire. The covering was placed by a cement gun to the required thickness and is of the usual 1:2:4 mixture. It serves to protect the iron pipe against excessive temperature changes, and prevents the water on the interior freezing in winter time.

Doors are provided in the side so that inspection may be made at proper intervals to prevent rusting.

Messrs. John Inglis Company, of Toronto, provided and erected the penstock. All excavation and concrete work in connection with erecting saddles, bulkheads and foundations was done by the company. Shop and field inspection of the steel work was in the hands of the R. W. Hunt Inspection Company, of Montreal.

Valve House

Over the butterfly valve at the lower termination of the penstock, a concrete building with drains was constructed, the floor of which has been made into a workshop for repairs to machinery, etc. A small lathe and emery grinder and an electric drill have been furnished. This building has a concrete saw tooth roof, in two spans, which gives good lighting, although the building is on the north side of the power house proper, and lies so low that wall lighting is practically impossible. Light is also admitted to

Forebay and Penstocks—No. 4, to left, 740 ft. long, 11 ft. diameter.

:ks, Reinforced Concrete Power House and Tail Race—Kaministiquia River in Foreground and Transmission Line to the Right.

the power house from this building, through clear glass windows. In this same building is a water motor with gearing for operating the large butterfly valve of the penstock and turbine. It is reversible and controlled by hand wheels in the power house. The water supply to drive this motor is obtained from an independent source, making the whole installation reliable for use in emergency. The joint between the butterfly valve and turbine inlet pipe is a special type consisting of a groove on the interior of the pipe into which ½-in. lead packing is caulked. Short steel fillers on the outside, against which the flange bolts are drawn tight, leaves the lead to be forced into all small openings by the pressure of the water on the interior side and will also allow the large valve to be removed in the future, should any repairs become necessary.

Turbine

This unit, supplied by Messrs. J. M. Voith, is a twin spiral, inward flow, Francis type wheel with a maximum B.h.p. of 12,500. The supply pipe from the 9-ft. diameter inlet valve is a tapered steel pipe embedded in concrete and is furnished with a drain to take away leakage from the inlet valve, and empty the turbine when the latter is closed down. Water is distributed around the two cast iron wheel cases, with arm inspection covers, through balanced steel gates, the openings through the same being adjusted by the governor in accordance with the load on the unit. From the gates it passes to enamelled bronze runners attached to the steel shaft, which is directly coupled at one end of the generating unit. The water then discharges into a central pipe or draft tube gradually increasing in size until it reaches the tailrace. This draft tube is steel for seven feet and then concrete to the outlet and is curved to discharge the water horizontally. It is seven feet in diameter at the point of discharge from the turbine, and is rectangular in form at the point of discharge, being nine by sixteen feet. The surface was carefully smoothed to obtain proper discharge with a maximum efficiency in the turbine.

A relief valve 5 feet in diameter serves to discharge the water when the load is suddenly thrown off the unit, and prevents excessive rise in pressure in the penstock, or water hammer. This valve is kept closed normally by oil pressure from the governor pump, but open by means of a piston valve, which relieves the pressure when the governor gates close rapidly. The time and distance of opening and closing are capable of adjustment by means of dash-pots.

The governor is of the fly-ball and relay type, operated by oil pressure from a belt-driven rotary pump, at a pressure of 280 lbs. per square inch. It serves, by means of mechanical connections to a cylinder and piston, to keep the turbine gates at the proper opening to supply water for any load which may be applied to the turbine, and to keep the speed constant at all loads and within set limits under load variations. A relay valve connection from the fly balls, controlled through dashpots and a spetial regulating mechanism, admits and discharges oil from each side of the piston in the main cylinder as required, thus adjusting the cylinder and the gates as the load changes.

Foundations.—The foundations for such a heavy unit, which weighs nearly 400 tons, are necessarily very massive. The generator, situated nearest the tailrace end of the power house, is carried on a massive arch, 28 ft. span and semi-circular, rising from the bottom of the excavation for the discharge water, 31 feet below the level of the power house floor and running 20 feet back from the wall of the building. The remaining 37 ft. width of the building is taken up with the various pits connected with the turbine inlets, outlets and drains. The excavation runs from 13 to 31 feet below floor level. An arch 10 ft. in diameter allows the penstock to enter the building at the front of the building.

The forms and centres for the arches, draft tubes, relief valve, etc., entailed much special work. Those for the curved draft tubes were built on wooden ribs of 2-in. planking spaced about 2 ft. apart and properly braced with ½-in. x 3-in. poplar strips nailed thereon to give the proper form to the tube. Openings with small clearances were left for parts of the machinery below floor level, which, after being placed and secured in position were grouted in place in the usual manner.

Generator

This machine, directly coupled to the turbine described, was built and installed by the Canadian General Electric Company, of Peterborough and Toronto. It is capable of generating 9,375 kv.a. at 257 r.p.m. and 4,000 volts, with a continuous overload capacity of 25 per cent. or, 50 per cent. for one hour. The total weight of the machine is 298,000 lbs., and the revolving field weighs 153,000 lbs. The armature is wound in two separate circuits entirely independent of each other, each connected to a bank of air blast transformers. The unit is of the horizontal shaft type; the shaft diameter being 13 inches.

The field is supplied with direct current from exciters

(Concluded on page 161)

The Larger Use of Reinforced Concrete in Sewer Construction

By W. W. Horner*

UP to 1900 sewers were constructed of brick and stone, sometimes accompanied by concrete backing and occasionally of plain concrete. From long experience with these materials, certain typical sections had been developed of which the circular and egg-shaped brick sewers in the smaller sizes were more common. For larger sizes some form of arch with a generally flat invert was used. In much of the older work the base or bottom was actually a timber grillage, and contained lumber up to 12 x 30 in. sticks. In the later construction an inverted arch of cut-stone or brick on a concrete bed, was substituted for the timber. Above the base the sewer consisted of heavy sidewalls or abutments and a semi-circular brick or stone arch, haunched with rubble masonry and later with concrete. Occasionally on projects of great magnitude, a closer study of the lines of pressure resulted in modifications of this type and some examples of elliptical, catenary and parabolic arches were found. It appears evident that most of the sewer arches in that period were not the result of stress analysis but were proportioned by arbitrary rules resulting from a study of existing structures.

About 1900 reinforced concrete had been taken up in many fields of construction and had been applied to long-span arches and the advantages of its use in sewer construction were soon appreciated. During the next five years, many examples of concrete sewers are found, although with a few exceptions the reinforcement consisted of wire mesh or expanded metal and there was an evident tendency on the part of the majority of engineers to use rather heavy sections similar to the plain masonry types. A few examples are also found of extremely radical designs involving very light sections heavily reinforced. These two extremes suggest the difference between the sewer engineer adapting his designs to reinforced work and the concrete expert breaking into the sewer field. In the last 10 years, all of these ideas have been through the melting pot, and we are beginning to find certain standard types of reinforced concrete sewers used generally. These are the horseshoe type varying in proportions from the semi-circular to those of about equal height and width, and the elliptical usually constructed as a five-centered arch. Of exceptional advantage under certain conditions the box or slab section is often employed, but under average conditions it is less economical than the other types. The circular sewer is difficult to construct in what is known as "monolithic" work, that is, if built in place, but the circular reinforced concrete pipe developed along other lines has become standard construction in size up to about 8 ft. It is unit work and may be considered as a factory product, and for that reason a much more satisfactory concrete can be secured through its use than is generally obtained in monolithic work.

Cross-Sections.

In many cases, the shape of the sewer will be controlled by local conditions. In wet ground the invert must be kept as high as possible and a broad shallow section results. For such cases the semi-circular shape is the most economical, and in fact is about the limit of distortion in that direction, as computations show that little further decrease in height can be obtained by adopting a wider, flat segmental arch. For such extremes where the semi-circular is not satisfactory, it is possible to design a box section, and if necessary, a multiple box, though this latter should always be compared with a similar multiplication of normal arches before being adopted.

Where the sewer is deep, and in particular, if in rock, there is usually economy in making the heights of the section greater than the widths, and if in deep rock cut, it is possible to use plain concrete sides and a flat arch abutting on the rock.

Under average conditions the most economical section is undoubtedly one approaching nearly to the circle, that is, having width and height about equal, but on account of the difficulty of securing satisfactory construction with a semi-circular invert, a segmental invert (usually a 45- to 60-deg. segment) has been common.

Use of Arch Sections

For loads due entirely to earth pressure and for sewers through fully developed territory where the loading can be definitely determined, arch sections of the semi-elliptical or similar types can undoubtedly be used to advantage, as the concrete can be worked in direct compression for the normal load and reinforcing put in to allow for unusual conditions. But where the loads cannot be predicted with reasonable accuracy or where extreme loads of opposite character must be provided for, there will be little difference between the semi-elliptical and semi-circular sections and there is undoubtedly a prejudice in favor of the latter.

The great advantage of the reinforced arch for use in sewer construction lies in the economy in material. Except in extreme instances where the box or slab construction is employed, an equally satisfactory sewer may be built of brick and mass concrete, but in large sizes, 8 ft. or over, the reinforced concrete sewer requires only from 60 to 80 per cent. as much masonry as the "gravity" type. Also where the amount of concrete per foot is sufficient to warrant an efficient plant the unit cost of the concrete should be somewhat less than that of good brick masonry. In addition to the saving in masonry, there is usually an accompanying difference in excavation and in deep work this may be a material consideration. Finally there may reasonably be a difference in required size of sewer due to the greater smoothness of good concrete work, which amounts to between 5 and 10 per cent. reduction in mean diameter.

It has been the writer's experience that for sewers up to about 8 ft. in diameter, brick work is probably more economical than concrete and that for larger sizes the reverse is true, the saving in favor of concrete increasing with the size. This is, of course, in the light of local conditions and might be modified for other cities. The comparison is based on work in the open where sufficient ground is available for plant and

* Engineer in charge of design, sewers and paving, St. Louis, Mo., before American Concrete Congress, Chicago.

material storage, and the statement must be again modified if the work is to be done in congested districts. As an example, it was recently considered economical to build a 14-ft. sewer of brick because of its location through a solidly built up residence district of the city.

There can be no question that reinforced concrete is the natural engineering solution for the problem of large sewers. If reasonably designed and carefully constructed, it gives the best and cheapest sewer. In the hands of a designer not thoroughly familiar with the conditions surrounding sewer construction and maintenance, or of a contractor not experienced in reinforced concrete work, it is likely to be a dangerous material and it is a much too common occurrence that work is handled under just these conditions. The fact that many of these sewers are built by contractors whose experience has been with massive masonry, has not tended to add to the safety of the finished work.

While some of the old sewer engineers have built reinforced sewers that would be reasonably safe and without reinforcement, there are many examples of exceptionally thin sections. These, the writer believes, are the result of assumptions that concrete can be placed in a sewer ditch with the same success as in a building and that the loading can be accurately forecasted. To eradicate this idea a brief description of average construction conditions may be warranted.

Construction

There is no class of work in which so many difficulties surround the successful placing of reinforced concrete as in sewer work. Sewers are usually constructed along public streets or alleys at considerable depth below the ground, or if in shallow excavation, are likely to be along the general trend of some water course and may often cross and re-cross a running stream. For these reasons, the excavation is usually difficult and the sides of the trench hard to support. Probably the best work can be secured in the open country, where the sides of the trench can be sloped. In this case, there is no cross bracing to complicate the form work and outside forms can be used and removed. Where the sides of the trench must be vertical, it is necessary to put in horizontal planking and cross bracing as the excavation proceeds, and it is economy to use as little lumber as possible below the spring line of the sewer, as such lumber is necessarily concreted in and lost. For the same reason, outside forms are not customarily used for the lower portion of the work.

When the excavation is complete, the invert is concreted. In rock or in dry ground, this can be done efficiently but if water or mud is present, a portion of the concrete is sure to be unsatisfactory. With very bad bottoms, it is often necessary to place a raft of extra concrete and allow it to set before attempting to place reinforcement. If such conditions appear possible, good practice will provide for this work in both specifications and estimate and many reasonably provide for underdrains to relieve the new concrete of damage from water flowing from the trench ahead. Unless the specifications are to provide that the work is to be expensively delayed, it should be noted that there will be quite an amount of working over and across the new invert while the concrete is setting and exposed bars left for splicing are likely to be bent and jarred and their bond value in the invert concrete decreased. Also because of these stub bars, it is usually impracticable to protect that portion of the invert from dirt and rubbish. While it is generally the custom to leave the sides of the invert rough to furnish a bond with the arch, it is an open question whether the finishing of this concrete smooth is not the lesser evil, as it can then be thoroughly and efficiently cleaned before additional concrete is laid.

Before the arch forms are set, it is necessary to remove cross bracing up to the crown level, and it must be replaced with verticals bedded in the new invert and cross-braced above the crown. Even with the most careful work, this will produce some disturbance with the sides of the trench and may even allow a bulging of the side plank enough to protrude within the neat measurements of the sewer. To widen and rebrace the section from the surface down may be expensive and hazardous as well as disorganizing, and the engineer often faces the problem of modifying the section instead. The writer recalls instances where the contractors have even asked permission to fill the whole trench to the top of the sewer with concrete at their own expense, rather than to attempt the re-excavation, and the construction engineer must be able to decide whether the deficiency in thickness at the sides can be compensated in this matter.

Collapsible steel forms are usually favored for the arch, and if kept well cleaned and oiled produce the best interior surface, but well-made wooden centers carefully planned will result in more satisfactory work. The choice will usually depend on the contractor's organization and schedule, as greater progress with one outfit can be secured if the collapsible forms are used.

Under the conditions prevalent in this work, the setting and holding of the arch reinforcement in accurate position is especially difficult and the importance of accuracy is rarely appreciated by foreman and laborer. When properly set, the rods are difficult to hold during concreting, as it is often necessary for the men to stand on the reinforcing while spading the concrete. The cost of special chairs or holders for the reinforcement is usually well warranted.

Breaks Up the Aggregate

The placing of the concrete is made especially difficult because of the double mat of reinforcing bars, which tend to break up the stream of concrete and to cause a separating out of the aggregate. The concrete is also likely to be lowered in quality by an almost unavoidable leakage of water. The concrete is also contaminated to some extent by earth and rubbish knocked from the surface into the forms. There occurs, also, even in the best regulated work, certain small slips of earth from between the side planking, and it is possible that portions of the clay or loam may be churned into the concrete before it can be cleaned out from between the tangle of reinforcement

In view of the unavoidable construction contingencies inherent in this class of work, the writer would recommend to the designer the following prescription:

1.—Use the best grade of concrete and considerable excess of mortar.

2.—Do not work concrete at more than 450 lbs., unless the construction conditions are to be exceptionally favorable.

3.—The concrete cover outside of the steel should be at least 2 ins.

4.—Use a minimum thickness of concrete of about 9 ins. unless the work is close to the surface, or is to be built under very favorable conditions, and increase this minimum and also the cover over the steel if the conditions are likely to be very unfavorable.

5.—Specify the setting of the reinforcement with especially designed holders. These might be made of cast iron and left in the concrete.

6.—If there is any possibility that the trench will be very wet or mucky, provide for a sub-case of concrete and provide means of keeping the trench work away from the work, if possible.

7.—To secure a concrete that will flow into place with the least assistance, a specification for a 2½ or a 3-minute mix should be seriously considered, as might also the use of hydrated lime. This would naturally result also in a denser and more waterproof concrete and might be a very considerable factor in prolonging the life of the reinforcement.

8.—Provide for a lining of vitrified brick for the invert, or at least provide an excess internal area to allow for such a lining at some later date. This is of more importance in maintenance than in construction, as under average conditions it is easier to obtain a reasonably smooth invert with the brick than to attempt to finish the concrete itself.

9.—Specify cold weather methods. Concrete can be placed satisfactorily and economically at even a zero temperature, if proper precautions are taken. It should be noted, however, that it is quite easy to overheat the finished concrete and to drive out a portion of the water.

In the St. Louis work, it has been customary to heat the water by turning exhaust steam into the water tank whenever the temperature goes below 40 degrees or whenever there is frost in the materials. In colder weather, steam coils are used in the said storage piles and often in the piles of coarse aggregate. It is also customary in freezing weather to place salamanders inside the arches and to hang tarpaulins at each end of the unit constructed. The top of the sewer has generally been protected by a covering of tarpaulin or plank, on top of which manure is piled

Loading

The loads to be considered are first, direct weight of the earth filling; second, horizontal or inclined pressures induced by the weight of this filling and the adjoining earth; third, pressures due to transmitted surface loads.

The relative values of these pressures will depend on the depth and size of the sewer and on the use to which the ground surface may be put.

Vertical Loads—It is always safe and usually reasonable to design for vertical loads equal to the full weight of the superimposed earth. Recent investigations of small sewers and pipes have shown that, due to some arching action of the earth itself, the full dead weight is not always applied to the sewer. The allowable reduction, however, seems to be of little importance until the depth of the fill is at least equal to the width of the trench and would only amount to about 25 per cent. when this depth is twice the width. The work of Marston and Anderson indicates that for depths of 10 to 15 times the width only 30 to 40 per cent. of the load is carried by the sewer. For a sewer more than 8 ft. in width, the depth of cover will rarely exceed twice the trench width, so that the reductions are hardly worth taking into account. There must also be reasonable doubt whether the gradual settlement does not finally increase the weight on the sewers considerably above the values given.

Horizontal Pressure.—There is so much doubt as to correct values of horizontal pressures, even for a given soil condition, and the pressures will vary so greatly in the different soils that the designer can only attempt to make a safe guess at the correct amounts to be used.

According to Rankin's theory, the intensity of horizontal pressure cannot be less than one-third of the intensity of vertical pressure for a particular depth and in ordinary clay it is customary to consider it as one-half of the vertical. For saturated ground, the earth will approach the condition of a fluid and the horizontal and vertical pressures would be equal.

Surface Loads.—Where sewers are constructed in city streets, the heaviest surface load would be the weight of a road roller, and this might be taken as 15 tons on an area of 5 sq. ft. at the surface, distributed downward along an angle of 30 deg. with a vertical. At a depth of 10 ft. this would approximately be equal to 200 lbs. per square foot on an area of 11 x 15 ft., or roughly equivalent to an additional 2 ft. of fill. If there are railroads crossing the line of the sewer, or if it seems at all possible that such roads be built, the sewer should be designed for locomotive loading in the same way. A fair value for this loading would be 80 tons on an area of 10 x 20 ft. at the surface. Distributed as above, this would be equivalent to about 300 lbs., per square foot over an area of 20 x 30 ft., at a 10-ft. depth and would give the same pressure as 3 ft. of additional fill.

For very light covers, these values would, of course, be increased, and it might even be reasonable to provide for impact, but for depths of cover for 6 ft., or more, it is usually satisfactory to treat such loads as additional weight of earth and allow them to increase both the vertical and the horizontal pressures. Allowance for foundations and for piles of material may be handled in the same manner.

Combination of Loading.—For final conditions, that is, after the backfill has reached a state of settled equilibrium, the sewer will be subject to a direct combination of horizontal and vertical pressures. It should be noted that the greatest bending moments in the arch will be due to vertical loads alone. Horizontal pressures usually induce moments of the opposite kind. The combination of vertical and horizontal pressures, therefore, while increasing the direct normal compression in the arch, will give smaller bending moments than those from the vertical loads. While the stress in the arch may finally reach the values derived from a proper combination of the two classes of forces, yet it is quite common for the sewer to be subject only to pressure of one kind during the construction period. Examples of this are as follows:

(a) A trench is excavated through hard clay which requires little bracing and will stand vertically for some time. The trench is backfilled with the same material. Then the full weight of the backfill may act vertically on the arch for some time before the sides of the trench finally slip and add also a horizontal pressure.

(b) In the example above, the sides of the trench may slip in against the sewer before the backfill is placed, producing heavy horizontal pressure and bending moments of reverse character.

(c) A trench through soft ground is held by sheet piling. When this piling is pulled there may be an appreciable time before the earth at the sides closes in and fills the void left by the piling. During this time the vertical loads only will act.

(d) In the above example, if the sheet piling is drawn before the backfilling is started, the earth at the sides may cave in and produce horizontal pressure with very little vertical load.

Loads of these kinds will only occur while the arch is new, possibly before the concrete has attained more than half of its normal strength. If the design contains a factor of safety of four for combination of pressures, and the concrete is only 10 or 15 days old, the arch would be about on the point of failure for vertical loads.

It would seem, therefore, that the design should provide for vertical loads alone, or at least in combination with a very small horizontal pressure on the arch only (not against vertical side walls.) This loading will be critical and from it the dimensions of the concrete and one set of reinforcements will be determined. The arch so determined should then be designed for horizontal pressure in combination with as little vertical loads as may seem possible. From this the reverse reinforcement may be calculated. Finally it is of interest to compute the stresses under normal combination of the two.

Three Fine New Schools for Municipality of Kildonan, Man.

Three large schools have recently been erected by the Sutherland Construction Company for the Municipality of East Kildonan, a suburb of Winnipeg. Each of these schools is of the same design and practically the same size. We illustrate one herewith—the Lord Kitchener School.

These three schools are thoroughly modern and are of absolutely fireproof construction. They each have a stone and concrete foundation. The outside finish is Fort William pressed brick, backed with hollow load bearing tile, the division walls being of the same tile, which material was supplied by the Dominion Fireproofing Company, Winnipeg. These tiles are made in Medicine Hat, Alta. All windows throughout these buildings are steel sash.

Each school is two stories and basement high and cost approximately $50,000. The basements, which are 11 feet high, are used as playgrounds. The total height of the schools is 52 feet. The interior finish is oak, and the floors in the corridors are of mastic asphalt. All floors in classrooms are reinforced concrete covered with maple flooring. The roofs of all three schools are sheet metal. The buildings are steam heated and electric lighted.

The electric light contracts on the three schools were let to Scorer Bros., Winnipeg. The plumbing and heating on two schools were let to Gates & Sons, while on the third school this contract was let to J. Thompson. The painting contracts were let to Robert Crawford, while Brown & Rutherford supplied all the interior finish. The Alsip Brick and Tile Company supplied all the common brick used in these schools. The Winnipeg Steel Granary and Culvert Company supplied the sheet metal and calimini doors in corridors. The stone used was supplied by Gillies & Son. The mastic asphalt in the corridors was put in by the Canadian Johns-Manville Company, and the ornamental iron work and stairs were supplied by the Vulcan Iron Works, Winnipeg. All these firms except the one supplying the pressed brick belong to Winnipeg. J. D. Atcheson & Co. were the architects for the three schools.

Mr. John E. Russell, 307 Logan Avenue, has been appointed Toronto representative of the Union Cement Company, Limited, of Owen Sound, Ont.

Lord Kitchener School, East Kildonan, Man.

A Gyratory Foundry Riddle

The cost of labor is the largest item in the making of castings, and the device described herewith materially reduces this cost. This device is a new and unique foundry riddle of the gyratory type. The motion of the riddle is obtained by the inertia effect of an unbalanced flywheel which causes every part to gyrate. This motion is unusually well adapted for sifting sand, since a lot of the energy is not wasted in throwing it against the ends of the compartment, as is done in a reciprocating type. Each particle of sand travels around in a circle, so that the small particles reach the sieve in the shortest possible time and the sifting takes place with great rapidity. The outfit complete weighs only about 90 pounds and so can be easily moved from place to place as it is needed. The riddle is particularly useful suspended from a trolley running on a cable stretched parallel with the line of moulders in the foundry. Owing to its design there are no obstructions in the way of a shovel, and, being

supported from above, a wheelbarrow can be run under the riddle for receiving the sand.

The riddle is operated by a Westinghouse totally enclosed 1/6 h.p., vertical motor, made especially for the Great Western Manufacturing Company, of Leavenworth, Kansas, who manufacture the outfit. As the total power is obtained from the unbalanced effect of the flywheel the horse-power to drive the riddle is very low and a cord and plug fitting any lamp socket is furnished with the motor so that no special wiring is necessary for the installation of this machine. The motor has a ball thrust bearing, and a total of only three bearings are used in the drive, all of which are dust proof. The sieve is 20 inches in diameter, and with this size the riddle will do the work of ten men sifting sand by hand. In fact, the sifting is done so quickly that it will riddle faster than one man can shovel in the sand. As the sieve does not have to be connected to the motor by connecting rods, etc., it can be easily and quickly removed from the clamping device for dumping. The machine mixes as well as sifts, so that one turning of the sand is eliminated, and not only the time of making the mold is reduced, but a better mold is insured after drawing the pattern.

Conference on Road Construction

(Continued from page 152)

ing the superintendents in their work. Mr. Hogarth replied on behalf of the engineers, expressing their appreciation of the way the superintendents entered into the discussion of their various papers, and the interest shown. Their aim had been to make the conference as practical and useful as possible, and from the interest displayed it was evident they had to some extent succeeded.

Mr. Huber, member of the Department's staff, spoke on the tremendous importance of having the records accurately and clearly made out, and asked the engineers to co-operate with them in this respect.

Mr. McLean Is Appreciated

On Friday morning, Major Sheppard, Mr. Talbot, Mr. Wilson, and Mr. McClure, on behalf of the road superintendents, presented Mr. McLean with a gold-headed cane, suitably carved, to commemorate the event and in appreciation of his services to the county road superintendents in assisting them in their work; also as extending to him their hearty congratulations on the appreciation of his merits by the Government indicated in his appointment as Deputy Minister to the new Highways Branch of the Department of Works.

Toronto Section C. S. C. E.

(Continued from page 142)

dam, which is the best and largest example of hydraulic fill construction in Canada, is 99 feet in height, 950 feet in length exclusive of spillway. The storage obtained by building this dam amounts to 180,500 acre feet, or 7,873 million cubic feet. The lecturer decribed in detail the hydraulic sluicing operations in which 4 inch and 5 inch monitors were employed with a nozzle pressure of 80 lbs. per square inch. Of the 550,000 cubic yards of material in the dam, 427,000 cubic yards was placed in position by sluicing, the remainder—consisting of heavy rock toes—being placed by electrically operated cableways. A description was also given of the intake works for the supply of water to New Westminster, and some interesting data regarding the rainfall in this part of British Columbia which has varied at Coquitlam between the extremes of 132 inches and 190 inches, the average being 153 inches per annum.

At the conclusion of the paper an interesting discussion took place and many questions were asked the lecturer, after which a hearty vote of thanks was tendered Mr. Conway for his very interesting and instructive address.

Invitations have been sent to the governors of the several states of the Union and to the lieutenant-governors of the provinces of Canada, with the request that they attend and appoint delegates to the Thirteenth Annual Convention of the American Road Builders' Association, to be held in Pittsburgh, Pa., during the week beginning February 28th.

Branch Managers' Convention Great Success

The last week in January was a notable one for the Trussed Concrete Steel Company, as it marked the first annual convention of the branch managers held at their main plant at Youngstown, Ohio. Men gathered from every section of the country to co-operate in formulating improved methods which would render greatest service to their clients. Not only every section of the country was represented, but representatives were present from far distant countries, including Japan, Hawaii, South America and Porto Rico. Fully one hundred men were in attendance.

Calgary Branch C. S. C. E.

The Calgary Branch of the Canadian Society of Civil Engineers held its first dinner of the season at the Alexandra Hotel on January 13th. A. G. Graves, Commissioner, City of Calgary, gave a very interesting address on the "Administration of Public Utilities" and showed that Calgary's public utilities compared favorably in service and cost to the public with other cities in the Dominion and elsewhere. His Worship Mayor Costello and Commissioner J. H. Garden were also guests of the Branch. Mr. S. G. Porter is secretary-treasurer of the Calgary branch.

National Iron Works get Contracts

The National Iron Works, Limited, of Toronto, have been awarded a very considerable contract by the city of Ottawa. This contract consists in the supply of 18-in., 20-in., 24-in., 30-in. and 36-in. cast iron water-pipe, aggregating some four thousand tons. This contract is in connection with the city of Ottawa's new water system, and delivery will have to be made during the spring and summer of 1916. Mr. R. L. Haycock is waterworks engineer of the city of Ottawa, and has charge of the designing and construction of the new system.

Mr. Mack Lectures on "Condulets"

At a meeting of the Toronto Branch of the Ontario Electrical Contractors' Association, held in the association rooms on Wednesday evening, February 2, Mr. Ed. Mack, of the Crouse-Hinds Company of Canada delivered an address on his company's products. Mr. Mack illustrated his remarks from the very complete catalogues published by his company and also from an extensive line of samples of the Crouse-Hinds condulets. He described in detail the process of manufacture, pointing out the care taken at every stage in order to insure perfect workmanship so as to avoid difficulties when the material reaches the job. He also fully explained the original system of catalogue numbers adopted by his company, whereby a numeral is selected for each size from ½ in. to 6 in., pointing out where this system worked to good advantage when ordering condulets with a multiple of outlets, such as T or X. Mr. Mack also pointed out that in view of the fact that they carried at all times three separate and distinct stocks—two at different stages of manufacture and one of the completed article—they were in a position to fill any order from either of these stocks, stating that if the fittings required were not found in their completed stock it would only take a few hours to finish from the rough state and make delivery. Mr. Mack also explained that the keynote of his company's policy was "Service to the Trade," and they stood at all times ready to make delivery of any special fittings or special drilling of fittings or covers to meet any particular requirement.

Mr. Mack's address occupied about an hour and a half and was followed by the members with keen interest. Arrangements were made for a party to visit the Crouse-Hinds factory, at some date in the future, where, as Mr. Mack stated, they would be shown every step in the manufacturing process.

The Kaministiquia Power Co.

(Continued from page 155)

which were already installed, at 110 volts, and is regulated, for constant voltage at terminus of transmission lines, by means of a Tirrill regulator in the exciter circuit. The transformers are of the air blast type and consist of three single phase units installed over an air chamber, each of 1,475 kw. capacity. Interconnected between generator and transformers are selector switches, with connections to a common 4,000 volt busbar, which enables the generator to supply current to other banks of transformers in case of trouble.

Switchboard

The usual recording, indicating, and switching apparatus is installed in the generator circuits, being connected to the switchboard through current and potential transformers to eliminate high voltage on the switchboard. An ammeter is installed in one phase of each bank of three high tension transformers, to indicate the proper equalized loads upon each. The switching apparatus is installed in reinforced concrete compartment, with switches in front and current transformers and wiring at the back; the latter, for all high tension work at 25,000 volts, is bare No. 4-O copper on porcelain insulators. Over-load, time limit relays guard the transformers and generator against excessive short circuits. A motor controlled generator rheostat adjusts the field, with a control switch on the generator panel.

In view of the fluctuating voltage of the exciter circuit, due to operation of the Tirrill regulator, a small 80 amp. hour battery has been installed to connect to the control circuit of the switchboard and provide a few lights in the power house in case of short circuits or other trouble cutting the generator and exciter supply down. This is charged from a small motor generator set with a panel near the main switchboard, so that the usual attendant may operate it. The same set also serves to charge the battery situated at the forebay, through a special overhead line. Push buttons and indicating devices on one panel of the switchboard indicate the position of the butterfly gates at the forebay and control the closing of each gate. The power house lighting, which previously had been from unshaded carbon lamps in lines along the walls, was changed to ceiling tungsten lights with concentrating reflectors, with six 150 watt tungsten units in a space 28 ft. x 50 ft.; this gives a more even distribution of light and, although at a height from the floor of 32 ft., gives sufficient light for all ordinary work.

Staff

The entire work was carried out under the direction of Messrs. R. S. Kelsch, of Montreal, Consulting Engineer to the company, and W. L. Bird, manager. Mr. Geo. Lewis was construction superintendent for all concrete work. The writer was responsible for all preliminary engineering data on aqueduct, penstock, generator foundations, etc., and for designs for aqueduct forms, forebay battery house, valve house and workshop and details of all small work, with inspection of electrical equipment and hydraulic work.

Montreal Tramways Company, Montreal, have awarded a contract for the first unit of their announced addition to their steam-generating plant. This will be a steam-driven turbo generator of a capacity of 15,630 kv.a., considerably the largest ever installed in Canada. It will be 60-cycle, three-phase, 1800-r.p.m., and generate at 5600 volts. This unit is being supplied by the Canadian General Electric

60,000 Kw. Units Contemplated

President E. M. Herr of the Westinghouse Electric & Mfg. Company, in a recent address before the Railway Club of Pittsburgh, said, "Due largely to the wonderful development in the steam turbine and its direct-connected electric generator, and the remarkably flexible, efficient and easy distribution of electricity, we are on the eve of notable advances in the utilization of electric power.

"First—the modern steam turbo-generator makes it possible to concentrate enormous amounts of power generation in one place.

"Second—this makes possible and advantageous very large individual generating units. The growth in the capacity of generators has really been enormous, made possible by the steam turbine.

"Third—Electricity can be transmitted long distances in large or small quantities and its characteristics changed at will all with small losses and at comparatively low cost."

The speaker then proceeded to trace the development of large generating units as exemplified by certain notable installations of central stations, industrial, and railway plants, and then discussed the effect of the concentration of such a large amount of power in one station. Mr. Herr said the building of units as large as 50,000 and 60,000 kw., was contemplated.

New Electric Railway in Three Rivers

With a fair amount of ceremony, the Three Rivers Traction Company, a subsidiary of the Shawinigan Water and Power Company, on December 11 inaugurated their electric tramway service. The line, of single track, is about three miles long, and runs in the form of a circle around the city, starting at the Canadian Pacific Railway station, taking in the residential district, along the river front, and returning to the station via the chief business thoroughfare. It has been decided to extend the system by building a line to Cap Madeleine, (a popular pilgrimage centre), which will also connect the Wayagamack pulp and paper plant and other industries with Three Rivers. Power is supplied by the North Shore Power Company, two Canadian Westinghouse 250 k.v.a. 550v. d. c. motor-generator sets having been installed for the purpose of the line. The poles are of steel in the residential and business sections and of wood in other districts. A car barn to hold ten cars, with repair shop, has been constructed. The six cars, manufactured by the Ottawa Car Manufacturing Company, are of the pay-as-you-enter type, each car being in charge of one man only who acts as motorman and also regulates the entrance and exit of the passengers. At the inauguration, speeches were made by the Hon. J. A. Tessier, the Mayor of the city and Minister of Roads for Quebec; Mr. Julian C. Smith, the vice-president of the company; Mr. W. S. Soper, of the Ottawa Car Manufacturing Company; Hon. Jacques Bureau, and others.

Trade Publications

Pumps—bulletin 108A, by the Wheeler Condenser and Engineering Company, Carteret, N. J., describing centrifugal pumps, single stage, double suction, up to 300-ft. head.

103. **Steel tubes.**—A Birmingham firm is open to purchase close-joint steel tubes for bedsteads or electric conduit work. Prices should include delivery Bristol or Liverpool, the former preferred. Samples may be inspected at the Department of Trade and Commerce, Ottawa.

Brownhoist—catalogue D, 1916, by the Brown Hoisting Machinery Company, Cleveland, Ohio, describing, with complete illustrations, tramrail systems, trolleys and electric hoists for handling all kinds of material, as manufactured by this company.

Dams and Weirs—by W. G. Bligh, Inspecting Engineer of Irrigation Works, Department of Interior, Canada. American Technical Society, Chicago, publishers. An analytical, practical treatise on gravity dams and weirs, arch and buttress dams, submerged weirs and barrages. The scope of this work may be judged from the following chapter headings: Gravity dams; Design of dams; Unusually high dams; Notable existing dams; Special foundations; Gravity overfall dams or weirs; Arched dams; Multiple arch or hollow arch buttress dams; Hollow slab buttress dams; Submerged weirs founded on sand; Open dams or barrages. Size, approximately 5½ by 8½ inches; 206 pages; well illustrated.

Personal

Mr. Paul F. Sise, vice-president and general manager of the Northern Electric Company, has been appointed adjutant of the 148th, a battalion organized in Montreal by Lieut.-Col. Magee for overseas service. Mr. Sise was formerly captain in the Victoria Rifles, and when the war broke out joined the Canadian Officers' Training Corps, which is affiliated with McGill University. Later, when the McGill Auxiliary Battalion was formed, Capt. Sise was in command of "D" Company, and afterwards of "A" Company, McGill Contingent, Canadian Officers' Training Corps. Considering the important executive position held by Capt. Sise, to say nothing of the responsibilities which such a position entails, it is impossible to underestimate the effect such a splendid example will have on his fellow Canadians. It typifies the calibre of the man and the loyal motives which are inducing our best citizens to answer the call of their country, and gives us certain confidence in the ultimate outcome of this great struggle.

Capt. P. F. Sise

Capt. Sise is only 36 years old. He was educated at Bishop's College School, Lennoxville, and at McGill University, from which he graduated with B.Sc. degree. He was one of the organizers of the University Club, Montreal, and is also a member of St. James Club and a Governor of the Western Hospital.

Mr. S. V. Kendall, Managing Director of Wm. Cowlin & Sons, Limited, general contractors, Toronto, has recently returned from England.

Mr. C. H. Rust, city engineer of Victoria, B. C., read a very interesting paper on the Sooke Lake Water-works at the annual meeting of the Seattle branch of the American Society of Civil Engineers held on January 31.

Mr. S. C. Wilcox, a former civil engineer with the C. P. R. at Kenora, Ont., and also at Winnipeg, has received a commission as Lieutenant in the 100th Battalion now in training at Winnipeg.

Obituary

Urgel Pauze, president of the Pauze & Fils Company, Limited, contractors, Montreal, is dead.

The death occurred on February 4th of Mr. Donald A. Munro, of Wolfville, N. S., at the age of 86. Mr. Munro was a prominent business man in the town. He carried on the business of carriage making for some years, finally taking up contracting and building and mill work.

A pioneer railroad builder of the West died recently in the person of Mr. N. P. Anderson. Mr. Anderson, who was a native of Sweden, came to Canada thirty-five years ago, and for twenty-nine years held responsible positions with the C. P. R. He was engaged on the construction of the C. P. R. through the mountains, and lived for many years at Revelstoke, B. C.

Mainly Constructional

East and West—From Coast to Coast

The Jos. Denis Company, contractors, Montreal, Que., have registered.

The Advance Engineering Company, Limited, Toronto, have secured a charter.

A charter has been granted to the Canadian Rock Drill Company, Limited, Toronto.

The Delorimier Architectural Steel and Iron Works, Montreal, Que., have registered.

Hamilton is erecting a nurses' home in connection with the Mountain Hospital at a cost of $30,000.

Forty-five building permits, of a value of $60,590, were taken out in Medicine Hat, Alta., during 1915.

Engineering and Construction Company, Limited (Laurin & Leitch), Montreal, Que., have registered.

A contract for a fuse factory has been let to the Atlas Construction Company, Montreal. The steel will be supplied by the Dominion Bridge Company.

Mr. G. B. Mitchell, C. E. and general contractor, has removed from the Jacobs Building, St. Catherine Street West, to 509-10 New Birks Building, Montreal.

The value of the building permits issued by the city of St. Catharines in January, 1916, is about three and a half times the value of those issued in January, 1915.

According to a reported newspaper interview with Mr. Grant Hall, of the Canadian Pacific Railway Company, the Rogers Pass Tunnel will not be electrically operated at present.

During the month of January, 1916, the city of Montreal issued 44 building permits, of a value of $174,160. In the same month of last year 73 permits, of a value of $203,261, were issued.

A company known as the Pembroke Iron Works, Limited, has been formed, with head office at Pembroke, Ont., and a capital of $100,000. The provisional directors are J. F. Munro, P. White, and T. Pink.

At the request of the Dominion Government, the International Nickel Company have undertaken to establish a plant for the refining of nickel in Canada. It is hoped that this plant will supply the entire needs of Great Britain and Canada.

Provincial Stone and Supply Company, Limited, have opened an office at Room 200, McKinnon Building, Toronto, for the purpose of dealing in crushed stone and builders' supplies. Mr. Robin Boyle, formerly of Niagara Falls, is manager.

Plans for a bridge over the Valley Inn, Hamilton, to be used in connection with the entrance of the Toronto-Hamilton highway to the city, will be considered shortly by the Board of Control. It is estimated that the bridge will cost $250,000.

In connection with the plans for reconstructing the Ottawa Parliament Buildings, two architects, Mr. John A. Pearson, of Toronto, and Mr. Marchand, of Montreal, have been appointed to examine the old walls and see how far they can be utilized in rebuilding.

La Fonderie d'Acier de Quebec, Limited, is the name of a new Quebec concern incorporated by E. Massicotte, of Sainte Anne de la Perade, and J. A. Larue, E. Trudel, W. Boulet, H. Groleau, E. Picher and N. Caouette, of Quebec. The capital stock of the company is $149,000.

According to a reply in the House of Commons by Hon. Frank Cochrane to a question by Mr. J. H. Sinclair, nearly $15,000,000 has already been spent on the Hudson Bay Railway project, and it will take at least another $10,000,000 to complete the undertaking. On the railway itself $9,557,340 has been spent in dredging, lighting, and other improvements at Port Nelson.

The following officers have been elected by the Engineers' Club of Toronto: president, W. A. Bucke; first vice-president, E. L. Cousins; second vice-president, L. V. Rorke; third vice-president, C. W. Power; directors, H. G. Acres, J. R. W. Ambrose, Alfred Burton, J. B. Carswell, A. G. Cumming, D. A. Dunlap, Arthur Hewitt, Chas. H. Heys, T. H. Stevens, M. P. White, T. S. Young; secretary-treasurer, R. B. Wolsey.

Mr. Burke, of Burke, Horwood & White, architects, Toronto, has been in Orillia conferring with the Town Council as to plans for the municipal building. He was asked to prepare an estimate for the restoration of the old building, with the addition of a foyer, to do away with the winding stairs. By various modifications it is hoped to reduce the cost of the building by $15,000 or more, compared with the plans submitted last year.

The old summer residence of Mr. Charles M. Schwab at Loretto, Pennsylvania, has been moved a distance of more than 1,300 feet on a forty-foot high trestle, and despite the fact that the building was moved over the tops of trees, several gullies and hills, not a picture nor piece of bric-a-brac in the house was shaken out of its accustomed place. The removal, to make way for a modern stone mansion to cost $750,000, is considered one of the greatest feats of house moving ever undertaken in this country.

The Geo. A. Fuller Company, Limited, Montreal, have obtained a contract for the construction of three mills for the St. Maurice Paper Company, Limited, at Cap Madeleine, P. Q. The company is a subsidiary of the Union Bag and Paper Company, Hudson Falls, N. Y., and is an amalgamation of the Cres Falls Company, Three Rivers; St. Gabriel Lumber Company, Limited, St. Gabriel de Brandon; and the Charlemagne and Lac Oureau Lumber Company. The new plant comprises a news print mill, a sulphite pulp mill and a kraft mill. The steel will be supplied by the Structural Steel Company, Limited, Montreal.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Collingwood, Ont.
Tenders on the construction of a steel water tower and foundations and the installation of pumping machinery will be received until 8 p.m., March 1st, by Hugh A. Currie, Chairman of the Water & Light Commission of the Town Council. Plans and specifications at office of the Consulting Engineer, W. Chipman, Mail Building, Toronto, and of the Commission.

Listowel, Ont.
The Town Council propose to lay a 6-inch main on Main Street in the spring. Clerk, M. M. Bright.

London, Ont.
Plans are to be prepared for an asphalt pavement to be laid on Hamilton Road for the City Council. Approximate cost, $50,000. Engineer, H. A. Brazier.

North Vancouver, B.C.
The District Council will endeavor to secure permission to run a watermain through the Lonsdale Estate to the premises of the Vancouver Creosoting Company. Clerk, J. Collins.

Ottawa, Ont.
Plans have been prepared for the construction of a sewer on Scott Street at an approximate cost of $3,500. Engineer, F. C. Askwith.

Peterborough, Ont.
The construction of a sewage disposal plant is contemplated. City Clerk, S. R. Armstrong.

Tilbury, Ont.
The Town Council propose to lay a sewer on Queen Street. Clerk, W. A. Hutton.

Toronto, Ont.
A Special Committee of the York County Council have recommended the improvement of 210 miles of roads during the next four years, at an approximate cost of $750,000. Engineer, E. A. James, 57 Adelaide Street E.

The Board of Control will receive tenders until February 29th for the construction of private drains in the City from April 1st, 1916, to March 31st, 1917. Plans, etc., at office of the Works Department, City Hall.

Works Commissioner R. C. Harris has recommended the reconstruction of a number of sewers in the City, the construction of a subway under the G. T. R. tracks at Ashdale Avenue, estimated to cost $33,370, and grading on Edna Avenue at an approximate cost of $7,893.

CONTRACTS AWARDED

London, Ont.
The Webster Construction Company, Bank of Toronto Building, have been awarded the contract for construction of sewers at Lorne Heights for the City Council. Approximate cost, $24,000.

Railroads, and Bridges Wharves

Brantford Township, Ont.
The Township Clerk, J. A. Smith, County Building, Brantford, will receive tenders until noon, February 26th, for the construction of the Fonger and Barton Bridges. Plans and specifications at office of the Engineer, A. M. Jackson, Temple Building, Brantford. Steel and concrete construction.

Brighton, Ont.
The Department of Public Works, Ottawa, have included in their estimates the sum of $24,500 for the construction of a wharf. Secretary, R. C. Desrochers.

Cockburn Island, Ont.
The Department of Public Works, Ottawa, have included in their estimates for the year the sum of $5,000 for an extension to the wharf. Secretary, R. C. Desrochers.

Deport Harbour, Ont.
The Dominion Government Department of Public Works propose to renew the wharf at an approximate cost of $5,000.

East Angus, Ont.
The Town Council propose to build a bridge at an estimated cost of $37,000, part of which will be provided by the Provincial Government. Concrete and steel construction. Clerk, R. C. Cowling.

Fort Frances, Ont.
The construction of a wharf estimated to cost $5,000 is contemplated by the Department of Public Works, Ottawa.

Huron County, Ont.
The County Council propose to lay a new floor on the bridge at Brussels and to erect several small bridges. Clerk, William Lane, Goderich.

Kagawong, Ont.
The sum of $15,000 for the construction of a wharf has been included in the estimates of the Department of Public Works, Ottawa.

North Vancouver, B.C.
The Dominion Government have approved the plans of the Amalgamated Dry Dock & Engineering Company for the construction of a dry dock and shipbuilding plant on the North Shore. Works will include a graving dock, buildings, marine railway and equipment, and are estimated to cost $5,500,000. Manager, J. L. Davidson.

Ottawa, Ont.
The City Council have decided to have plans prepared for a subway to be constructed on Robinson Avenue. Concrete and steel construction. Engineer, F. C. Askwith.

Quebec Province
The Vercheres, Chambly & La Prairie Tramways Company are applying to the Provincial Legislature for a charter to operate an electric railway in the Montreal District.

Renfrew County, Ont.
The County Council have accepted plans for a bridge over Indian River, estimated to cost $4,000, and will call for tenders shortly. They will have new plans prepared for a bridge over the Madawaska River at Burnstown, and will take the matter up at the June Session. Clerk, R. J. Rooney, Pembroke. Engineer, J. L. Morris, Pembroke.

Windsor, Ont.
The Essex Terminal Railway are considering the construction of about one mile of switches for factory facilities. Particulars from W. Woollatt, Walkerville.

Public Buildings, Churches and Schools

Alberta Province
The Department of Public Works, Ottawa, Ont., have made provision in their estimates for the following buildings:—Athabasca Landing, Public Building $5,000; Bassano, Public Building, $10,000; Calgary, Drill Hall, $99,000 Post Office, $110,000; Castor, Public Building, $16,000; Edmonton, Customs Warehouse, $75,000, Post Office, $100,000.

British Columbia Province
The Dominion Department of Public Works have provided in their estimates for the following buildings:—Ashcroft, Public Building, $25,000; Coquitlam, Public Building, $20,000; Courtenay, Public Building, $20,000; Fernie, Drill Hall, $20,000; Golden, Public Building, $20,000; Granges Harbour, Public Building, $5,000; Kamloops, Drill Hall, $29,000, Public Building, $75,000; Kelowna, Public Building, $30,000.

Caraquet, N.B.
The authorities of the Sacred Heart College, which was recently destroyed by fire, are having plans prepared for an entirely new building, but are not yet decided whether to rebuild on the old site or at Campbellton.

Drummond Township, Ont.
Tenders on the erection of a school will be received until March 10th by Richard Dowdall, R.R. No. 6, Perth, Ont. ad Public Buildings AWARDED $..

Ethel, Ont.
Alterations to the Methodist Church are being considered. Pastor, W. Johnstone.

Grey County, Ont.
The County Council have decided to hold over until the June Session the matter of awarding contracts for an addition to the Registry Office. Clerk, F. H. Rutherford, 863 Second Avenue, Owen Sound.

Haldimand Township, Ont.
The Trustees of School Section No. 2 contemplate the erection of a school at an approximate cost of $3,000. Secretary, W. H. Johnston, Grafton.

Leamington, Ont.
The Essex County Council are considering the erection of an addition to the House of Refuge at an approximate cost of $5,000. A report will be submitted by the Superintendent, Daniel Kennedy.

Medicine Hat, Alta.
The hospital which is to be erected on Crescent Heights for the Sisters of the Charges of St. Louis will probably be built in units. Financial arrangements are now being made. The first building is estimated to cost about $20,000.

Ontario Province
The Department of Public Works, Ottawa, have made provision in their estimates for the following buildings:— Fort Frances, Public Building, $25,000; New Hamburg, Public Building, $10,000; New Liskeard, Public Building, $20,000; Oakville, Public Building, $5,000; Penetanguishene, Public Building, $7,000; Picton, Post Office addition, $11,000; Port Stanley, Public Building, $5,000; Sault Ste. Marie, Drill Hall, $25,000; Southampton, Public Building, $20,000; Stratford, Public Building, $20,000; Sturgeon Falls, Public Building, $7,000; Sydenham, Public Building, $3,000; Wallaceburg, Public Building, $25,000; Watford, Public Building, $20,000; Weston, Public Building, $10,000; West Lorne, Public Building, $20,000; Wiarton, Public Building, $19,000; Windsor, Drill Hall addition, $25,000.

Paris, Ont.
The Salvation Army are now raising funds for the erection of a citadel at an approximate cost of $4,000. Work will not start until money is collected. Architect, G. Miller, Albert Street, Toronto.

Parry Sound, Ont.
The Board of Education are desirous of receiving plans and specifications for a six-roomed brick school. Particulars from the Secretary, J. D. Broughton.

Repentigny, Que.
The Roman Catholic School Board will receive tenders until February 27th for the erection of a school. Architect, R. Gariepy, 25 St. James Street, Montreal.

St. Remi, Que.
The general contract for alteration and additions to the Roman Catholic Church has been awarded to H. J. Bisaillon, St. Johns, Que.

Tilbury, Ont.
The Town Council propose to make a number of alterations to the Town Hall. Clerk, W. A. Hutton.

Winnipeg, Man.
It is proposed to build an annex to Grace Hospital, Preston and Arlington Streets. Particulars from Commissioner Sowton.

CONTRACTS AWARDED

Halifax, N.S.
The Department of Militia and Defence have commenced the erection of a hospital. The general, carpentry, roofing, plastering, painting and interior fittings contracts have been let to Col. Lowe, Halifax Hotel, the heating to Farquhar Bros., Barrington Street, and the electrical work to J. Starr & Company, Granville Street. Frame construction, concrete foundation, asbestos roofing.

Montreal, Que.
The Berlin Interior Hardwood Company, 72 Wilmot Street, Berlin, Ont., have been awarded the contract for the installation of examining warehouse fittings for the Department of Public Works, Ottawa.

Murray Bay, Que.
The contract for installation of interior fittings at the Post Office has been let by the Department of Public Works, Ottawa, to the Berlin Interior Hardwood Company, Berlin.

Shawville, Que.
The contract for installation of interior fittings at the Post Office has been awarded by the Department of Public Works, Ottawa, to the Berlin Interior Hardwood Company, Berlin.

Business Buildings and Industrial Plants

Calgary, Alta.
The Ford Motor Company, Ford City, Ont., have secured a site for the erection of an assembling plant on Eleventh Avenue, and will have plans prepared at once. Work will start as soon as weather will permit. Approximate cost, $200,000.

Coaticook, Que.
The Warrior Fabric Company propose to construct extensions to their factory. Manager, E. F. Tomkins.

Elmira, Ont.
Plans have been prepared for a business block to be erected on Arthur St. for William Moser. Tenders will be called shortly. Brick construction, concrete and brick foundation. Estimated cost, $4,000. Architect, John McMillan.

English Bay, B.C.
A company is being formed to build a pleasure pier, similar to those used at English holiday resorts. Particulars from A. W. Coates, 445 Granville Street, Vancouver.

Hepworth, Ont.
Victor Campbell plans to rebuild his store, which was recently destroyed by fire. Estimated cost, $6,000.

Montreal, Que.
Work has been started on interior alterations to a store at 327 St. James Street for the A. F. Gault Estate, 20 St. Alexis Street. Approximate cost, $3,000.

Hon. N. Perodeau, 506 Dominion Express Building, 145 St. James Street, proposes to rebuild his factory and store at St. Catherine and St. Urbain Streets, occupied by the Gold Medal Furniture Manufacturing Company.

Ovila Provost, 1219 Cote des Neiges Road, has commenced alterations to his store and residence, estimated to cost $4,000.

P. E. Bourassa & Son, 1495 Notre Dame Street E., are making alterations to their planing mill, estimated to cost $3,000.

Ottawa, Ont.
The electrical work required in connection with the addition now being built at the premises of the Capital Wire Cloth Company, Armstrong Avenue, will be done by the owners.

Prescott, Ont.
The Newell Manufacturing Company, Prescott, are receiving tenders for the installation of a heating plant. Specifications at office of the Company.

St. John's, Nfld.
The Reid Newfoundland Company propose to build a large shed in the near future.

Stratford, Ont.
T. J. Hepburn, Architect, 29 Downie Street, will receive tenders until 4 p.m., February 18th, for the erection of an addition to the factory of the Avon Hosiery Company, Erie Street. Estimated cost, $12,000.

Fire Chief A. S. Kappele, in the annual report, has recommended the erection of two sub-stations, one in the manufacturing district and one in the west end. City Clerk, R. R. Lang.

Toronto, Ont.
William Cowlin & Son, Mail Building, desire to receive sub-tenders on trades required in the rebuilding of the Princess Theatre.

The National Equipment Company, t Wabash Avenue, are building a paint shop, estimated to cost $17,500. Steel, frame and galvanized iron construction, felt and gravel roofing. Owners are doing most of the work.

J. T. & H. Hutson, 43 Victoria Street, are building a store and office building at 490 Yonge Street, at an estimated cost of $20,000.

Work will start shortly on alterations to a store at Yonge and Wellington Streets for the Wilkes Estate. Architects, Denison & Stephenson, 20 King Street West.

Vancouver, B.C.
Plans are being prepared for an office and theatre building to be erected on Hastings Street for Pantages Theatre, Seattle. Architect, B. M. Pretica, Pantages Theatre Building, Seattle. Approximate cost, $250,000.

The Hudson's Bay Company propose to make extensive alterations to their store on Granville Street, and to purchase a quantity of dining room, kitchen and lunch counter equipment. Work will start in about one month.

Wiarton, Ont.
Goldie Walker, Wiarton, is considering the equipping of a moving picture theatre. Seating and interior fittings will be required.

Windsor, Ont.
A. R. Bartlet, Windsor, is preparing plans for a factory to be erected for the Chalmers Motor Company, Detroit, Mich. The building may be erected either at Walkerville or Windsor.

CONTRACTS AWARDED

Hamilton, Ont.
The contract for heating and plumbing required in connection with the addition now being built at the factory of the Tallman Brass Company, Wilson St., has been let to Drake-Avery Company, 22 John Street S., and the electrical work to Culley & Breay, King Street West.

The general, masonry, carpentry and roofing contracts for the erection of stables for W. A. Freman Company, 181 Hunter Street E., have been let to W. H. Cooper, Clyde Building. Brick construction, concrete foundation, shingle roofing. Estimated cost, $3,500.

Hespeler, Ont.
The contract for carpentry required in the rebuilding of the factory of A. B. Jardine & Company has been awarded to Prestien & Bartles, Hespeler, and the masonry to Grill Bros., Hespeler.

Montreal, Que.
In connection with the repairs now being carried out at the business block at 91 Notre Dame Street W., the roofing contract has been let to George W. Reed & Company, Limited, 37 St. Antoine Street.

In connection with the alterations being carried out at the factory of the Brandram-Henderson Limited, 2983 St. Urbain Street, the contract for tiling has been awarded to R. S. Muir & Company, 92 Park Avenue. Remainder of work will be done by the general contractor.

Ottawa, Ont.
J. A. & H. Brouse, Sparks Street, have let the contract for alterations to a store front to F. M. Derwin, Chateau Laurier.

Preston, Ont.
The general contract for the erection of a store on Argyle Street for R. G. Wurster, King Street, has been let to N. Hiper, Waterloo Street. Work will start early in the spring.

Quebec, Que.
In connection with the warehouse and residence which have been built on Latournelle Street by C. E. Morissette, Limited, the contract for heating has been let to O. Picard & Fils, 199 St. John Street, and the plumbing and electrical work to Jobin & Paquet, 72 Abraham Hill.

Sherbrooke, Que.
The contract for electrical work at the addition which has been built at the factory of Walter Blue & Company, Limited, 8 King Street, has been awarded to the Electric Repair & Supply Company, 71 Wellington Street.

Simcoe, Ont.
Plans are being prepared for a garage to be erected on Robinson Street for E. Ramey. The general contract has been let to R. E. Gunton and the masonry to H. Weston. Reinforced concrete and brick construction, concrete foundation.

South Vancouver, B.C.
The contract for bulkhead work required in the construction of a creosoting plant for the Vancouver Creosoting Company has been awarded to Palmer Bros. & Henning, 929 Main Street.

St. Catharines, Ont.
The contract for masonry required in alterations to a building for A. Puccini & Company, 55 Front Street E., Toronto, has been awarded to T. E. Riley, James Street.

Toronto, Ont.
Work has been started on drilling test holes preparatory to the erection of a warehouse on Mutual Street for the Robert Simpson Company. The general contractors are Wells Bros. Company of Canada, Limited, Monadnock Building, Chicago, Ill. The contract for steel sash has been let to H. Hope & Sons, Limited, 45 King Street W. General contractors have opened an office at 96 Gould Street, with W. G. Luce in charge.

The Toms Contracting Company, Limited, have been awarded the contract for the erection of an addition to the premises of the Canada Metal Company, estimated to cost $15,000, and for the construction of a concrete and brick building for the Brown Copper & Brass Rolling Mills Company, New Toronto, to cost approximately $25,000.

Work is about to start on the construction of a store front at the premises of the House of Hobberlin, Limited, 151 Yonge Street. The contractors are the Kawneer Manufacturing Company, Limited, Kent Building. Estimated cost, $3,000.

Work has been started on an addition to a factory at Browns Avenue and Paton Road for J. A. Scythes & Company, 22 Church Street. The general contract has been let to J. W. Gray, Confederation Life Building. Brick construction, felt and gravel roofing Estimated cost, $3,500.

The masonry contract in connection with the workshop which is being built at 212 Simcoe Street for White & Thomas, 139 Simcoe Street, has been let to Teagle & Son, 310 Davenport Road, and the carpentry to Smith & McElroy, 208 Close Avenue.

Vancouver, B.C.
The contract for glass required in connection with the addition to the store of the Hudson's Bay Company, Georgia Street, has been let to W. N. O'Neil Company, Limited, 550 Seymour Street, and the painting to C. H. Brawn, Third Avenue E.

The general contract for the erection of an addition to the premises of the American Can Company, '535 Railway Street, has een let to the Dominion Construction Company, 509 Richards Street. Contracts for heating, electrical work and installation of elevators will be let later.

Residences

Brantford, Ont.
F. C. Bodley, 21 Temple Building, is preparing plans for a residence to be built at 45 Wellington Street for C. D. Chapin, 37 Wellington Street. Tenders will be called shortly. Brick construction, stor e and concrete foundation, slate roofing. Estimated cost, $5,500.

Grey Township, Ont.
W. G. Hemingway, Concession 11, Grey Township, Brussels, Ont., is preparing plans for a residence, estimated to cost $3,500. White brick construction, concrete and stone foundation.

Leamington, Ont.
F. C. Wheeler, Bells Point, Leamington, is preparing plans for a residence, estimated to cost $3,500. Red pressed brick construction, shingle roofing.

London, Ont.
Plans are being prepared by M. A. Thomas, 310 Dundas Street, for a residence to be erected on Cartwright Street. Work will start in the spring. Stucco and concrete block construction, concrete foundation. Estimated cost, $3,500.

Meaford, Ont.
Alexander Watson proposes to erect a residence and will prepare plans. Brick construction.

The erection of a residence is contemplated by William McCutcheon, and plans will be prepared. Brick construction.

Montreal, Q'e.
J. Gertler, 676 Drolet Street, has commenced alterations to a residence on Bellechasse Street. Estimated cost, $3,500.

Niagara Falls, Ont.
Mrs. C. W. Brown, 218 Bridge Street, is considering the erection of a residence. Plans not yet prepared.

Ottawa, Ont.
The erection of a number of residences is being considered by W. H. Craig, 245 Fourth Avenue. Stucco and brick veneer construction, stone foundation, shingle roofing.

M. C. Neate, Rockliffe Park, has prepared plans for apartments to be erected on Creighton Street at an approximate cost of $7,000. Brick veneer construction, concrete foundation, felt and gravel roofing.

Richards & Abra, Booth Building, are preparing plans for a tenement row and apartment house to be erected for W. A. Cole, 163 Sparks Street. Brick veneer construction, concrete foundation, felt and gravel roofing.

Rankin, Ont.
Tenders on the erection of a parsonage will be received until February 21st by Rev. J. Alberti, R. R. No. 1 Rankin. Plans and specifications at Fisher's store, Murray Street, Pembroke, and with the owner.

Sault Ste. Marie, Ont.
A. C. Boyce, M. P., is receiving tenders on repairs to his residence. Frame and brick construction. Estimated cost, $15,000.

Thorold, Ont.
T. A. Thompson, Box L, Thorold, is receiving tenders on the installation of a hot water heating system for a six-roomed residence.

Toronto, Ont.
A. MacLeod, 57 Benlamond Avenue, has commenced alterations to a residence at 45 Benlamond Avenue. Estimated cost, $4,500.

H. Pickering, 196 Robert Street, has started work on the erection of a residence at 198 Rushton Road. Smaller trades will be let. Brick construction, shingle roofing. Approximate cost, $4,000.

N. Hicks, 612 Delaware Avenue, is building several residences on Oakwood and Highview Streets. Painting, wiring, plastering, plumbing and heating not yet awarded.

Hayward & Whitehorn, 6 Hallam Avenue, are building a residence at 19 Lauder Avenue, estimated to cost $4,500. Plumbing, heating, plastering and painting not yet awarded.

Westport, Ont.
B. Dillon, King Street, Brockville, is preparing plans for a residence to be erected for G. W. Castle, Westport. Estimated cost, $3,500.

CONTRACTS AWARDED

Montreal, Que.
In connection with the flats which have

been built at 115 Marlowe Street by G. E. Blackwell, 4184 St. Cartherine Street, Westmount, the contract for tiling has been let to Labelle & Company.

The contract for roofing in connection with the flats which have been erected on Grant Boulevard for G. N. W. Zwinge, 296 Madison Avenue, has been let to J. Dunphy, 55 Barrie Street.

Ottawa, Ont.
In connection with the residence which is being built for O. B. Shortly, 197 Clemow Avenue, the carpentry, plastering and electrical work have been let to the general contractors, Cuthbertson & Clark, 706 Echo Drive, the painting to Ritchie & Nunn, Sunnyside Avenue, and the heating and plumbing to McKinley & Northwood, Rideau Street.

Quebec, Que.
The contract for plumbing and electrical work at the residence which has been built on Lamontagne Street for F. Nadeau, 40 Crown Street, has been let to A. Houde, 532 St. Valier Street.

In connection with residences which has been erected on Lockwell Street by A. Grenier, 294 Richelieu Street, the contract for heating, plumbing and electrical work has been let to P. Paradis, 236 D'Aguillon Street. Painting by owner.

The contract for painting required in connection with the residence built on Begin Avenue for G. Lambert, 296 St. Cyrille Street, has been awarded to Simard & Frere, 270 St. Joseph Street, and the heating, plumbing and electrical work to Asselin & Frere, 36 Boulevard Langelier.

In connection with the residence which has been erected on Eighth Street for W. Bouchard, 18 Second Avenue, Limoilou, the contract for heating, plumbing and electrical work has been let to G. Gobeil, 159 Ste. Marquerite Street. Painting and plastering not yet awarded.

Sarnia, Ont.
William Kennedy, Front Street, has had plans prepared for a residence to be erected on Proctor Street, and has let the general, masonry and carpentry contracts to G. A. C. Andrew, Marie Street. Frame construction, concrete foundation, shingle roofing. Estimated cost, $4,000.

Toronto, Ont.
G. Bailey, 79 MacKay Avenue, is building three residences on MacKay Avenue for J. Durham. Brick construction. Approximate cost, $7,000.

A. L. Sanagan, 132 Balsam Avenue, has comenced the erection of a residence, estimated to cost $3,500. The contract for plumbing and heating has been awarded to J. R. Seager, 799 College Street. Brick construction, shingle, felt and gravel roofing.

West Oxford Township, Ont.
Plans have been drawn for a residence to be built on Galway Street for George Cook, and the general contract let to R. Layton, Ingersoll, Ont. Smaller trades will be sub-let. Red brick construction, concrete and brick foundation, shingle roofing. Estimated cost, $3,000.

Westport, Ont.
The general contract for the erection of a residence for Rev. Father O'Rourke, Westport, has been awarded to J. C. Seagel, Westport. Brick construction, stone foundation, slate roofing. Approximate cost, $10,000.

Power Plants, Electricity and Telephones

Collingwood, Ont.
Plans have been prepared for the electrification of the paterworks pumps. If the Ontario Railway & Municipal Board approve, work will start at once. Engineers, Chipman & Power, Mail Building, Toronto.

Edmonton, Alta.
The Alliance Trust Company, 10 Clarence Block, Calgary, Alta., propose to form a separate company to supply power to this city. This is a counter-proposition to the Farrell Hydro scheme which recently passed the City Council but has not yet been ratified by the Legislature. President, R. B. Bennett, M. P.

Niagara Falls, Ont.
The Ontario Power Company and the Ontario Transmission Company, Ltd., propose to make extensions to their plant during the next two years, estimated to cost $3,000,000.

Speers, Sask.
A charter has been granted to the Speers Rural Telephone Company, and the system will shortly be constructed. Estimated cost, $12,000. Secretary, S. Chivers Wilson.

Strathroy, Ont.
The Town Council are considering the extension of the lighting system on McKellar and Caradoc Streets. Clerk, F. W. Atkinson.

Weyburn, Sask.
The City Council have applied for permission to raise $35,000 for an additional unit for the power plant. Clerk, E. H. Phillips.

Fires

Belle Plaine, Sask.
The store owned by J. H. R. Dickson has been totally destroyed by fire. Loss, $20,000.

Brockville, Ont.
Fire has destroyed the business block owned by W. E. Harding. Loss, $15,000, covered by insurance.

Comber, Ont.
The store of James Jenkins has been destroyed by fire. Loss, $7,000. Owner may rebuild in the spring.

Edmonton, Alta.
The factory of the Emery Manufacturing Company has been destroyed by fire. Loss, $100,000.

Montreal, Que.
The premises of the Gold Medal Furniture Manufacturing Company have been partially destroyed by fire. Loss, $25,000.

Ottawa, Ont.
Fire has partially destroyed the store and residence of Thomas Clarey, Centre Street. Loss, $4,000.

Quebec, Que.
Fire has partially destroyed the residential block at 27 Notre Dame Street, owned by Alfred Boivin. Loss, about $45,000.

Toronto, Ont.
The office building and warehouse at 19-23 Richmond Street W., owned by the Imperial Trust Company of Canada, 15 Richmond Street W., has been damaged by fire to the extent of about $20,000.

Fire has damaged the premises of the Ideal Bedding Company, 10 Jefferson Avenue, to the extent of about $3,000.

Winnipeg, Man.
The cafe and apartments owned by J. Hayes, Osborne Street, have been damaged by fire to the extent of about $5,000.

Miscellaneous

Bentinck Township, Ont.
The Township Council are receiving tenders on the supply of 12,000 feet of cedar flooring in 14-foot lengths. Reeve, George Brown, Bentinck.

Brussels, Ont.
The Town Council will shortly call for tenders on the supply of stone for street improvements. Clerk, F. S. Scott.

Burlington, Ont.
The Department of Public Works, Ottawa, have included in their estimates the sum of $12,000 for the construction of a revetment wall.

Dutton, Ont.
The Southern Ontario Gas Company, c/o W. Gall, Dutton, propose to sink additional wells in the spring and to lay supply pipes.

London, Ont.
The Southern Ontario Gas Company are having plans prepared for the extension of their piping system and the drilling of new wells in the spring. Work is estimated to cost $200,000. Manager, F. B. Tomb, 301 Central Avenue.

South Vancouver, B.C.
The Supplementary Estimates now being considered by the City Council include five sub-stations, $25,000, one combination pump, hose and chemical car, $12,200; one combination hose and chemical car, $7,500; one city service truck, $8,000, and ten fire alarms, $1,300. Clerk, J. B. Springford.

Stratford, Ont.
Fire Chief A. S. Kappele has recommended the installation of nine non-interfering signal boxes, one gasoline storage tank and the purchase of 1,000 feet of fire hose.

Toronto, Ont.
J. B. Smith & Sons., 53 Strachan Avenue, are in the market for one saddle tank locomotive, 25 to 30 tons.

Welland, Ont.
The Canadian Steel Foundries, Ltd., intend to expend $100,000 on new equipment, including one or two 35-ton open hearth furnaces.

CONTRACTS AWARDED

Bruce Township, Ont.
The contract for supply of tile and cement has been let by the Township Council to C. S. Woods, c/o the Clerk, J. G. MacKay, Underwood.

Winnipeg, Man.
The Winnipeg Aqueduct Construction Company have awarded a contract to the London Concrete Machinery Company for the supply of six centrifugal pumps, gasoline operated, and two Batch Mixers

Tenders and For Sale Department

Tenders for STREET CARS

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, March 14th, 1916**, for the supply and delivery of:

	Tender Numbers
One single-truck double-end street car, completely equipped, ready for operation, for Bloor Street Division, Toronto Civic Railway	37
One car body, double-end, single-truck, for Bloor Street Division, Toronto Civic Ry.	37-A
Equipment for one single-truck for Bloor Street Division, Toronto Civic Railway, electrical equipment	37-B
Equipment for one single-truck car for Bloor Street Division, Toronto Civic Railway, single-truck	37-C

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of city by-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman, Board of Control.

7-7

CITY OF MONTREAL

Refined Asphalt

Tenders, under sealed envelope, addressed to the Board of Commissioners and deposited in their office, at the City Hall, will be received until noon, **Thursday, Fabruary 24th, 1916**, for the supply and delivery of refined asphalt.

The quantity anticipated is about six thousand (6,000) net tons. It is distinctly understood that this quantity is but approximate, and the Board of Commissioners reserves the right to increase or decrease said quantity in any amount at its discretion without entitling the Contractor to any claim whatsoever.

Copies of specifications and forms of tenders may be obtained by the interested parties at the office of the Superintendent of Purchases and Sales, and all necessary information will be given at the Chief Engineer's Office.

All tenders not made on the form furnished for that purpose by the City of Montreal, and not sent in the printed envelope also furnished for that purpose shall not be entertained.

No tenders shall be considered unless the same be accompanied by a cheque accepted by an incorporated Canadian Bank payable to the City of Montreal, for a sum representing 10 per cent. of the total amount of the tender, which tender and cheque shall be enclosed in said envelope.

The lowest or any tender will not necessarily be accepted.

The tenders will be opened in the presence of the interested parties by the Board of Commissioners deliberating in its Meeting Room, at the City Hall, at the first regular meeting of the said Board, following the reception of the said tenders or on the date above mentioned, if the Board is sitting.

By order of the Board of Commissioners.

L. N. SENECAL, Secretary.

Board of Commissioners' Office,
City Hall,
Montreal, February 1st, 1916. 6-7

To Contractors

Sealed bids will be received up to noon, **Wednesday, February 23rd, 1916**, for all trades required in the erection of a warehouse building in Church Street, Toronto. The lowest or any bid not necessarily accepted. Plans and specifications may be seen at the office of the Architect, F. S. Baker, Traders Bank Building, Toronto. 7-7

Board of Education

Sealed tenders, addressed to the Secretary-Treasurer of the Board, will be received until

Thursday, February 24th, 1916
for

Electrical Work at Alexander Muir and Bolton Ave. Schools

Drain Work at Kent School

Ash Hoist and Fire Doors at Withrow Avenue School

Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto. Each tender must be accompanied with an accepted bank cheque for five per cent. of the amount of tender or its equivalent in cash, applying to said tender only. Sureties for all tenders exceeding four thousand dollars must be furnished by Surety Companies. Tenders must be in the hands of the Secretary-Treasurer at his office in the City Hall, **not later than 4 o'clock** on the day named, after which no tender will be received. The lowest or any tender will not necessarily be accepted.

W. C. WILKINSON, Secretary-Treasurer.
7-7 MILES VOKES, Chairman of Committee.

TOWN OF COLLINGWOOD
PROVINCE OF ONTARIO

Waterworks Extensions

Sealed tenders will be received by the Chairman of the Collingwood Water & Light Commission until 8 p.m. on

Wednesday, March 1st, 1916

for the following works:—

(1) Steel Water Tower.

(2) Foundation for Steel Water Tower.

(3) Pumping Machinery, comprising one motor-driven unit of 800 Imperial gallons capacity.

(4) Pump Well and connections.

Plans and specifications may be seen at the office of the Engineers, 204 Mail Building, Toronto, or at the Water and Light Office, Collingwood.

The lowest or any tender not necessarily accepted.

HUGH A. CURRIE, Esq., Chairman.
W. B. H. PATTON, Esq., Mayor.
STEPHEN BURNSIDE, Esq., Commissioner
E. J. STAPLETON, Esq., Superintendent.
CHIPMAN & POWER, Engineers. 7-7

WANTED

Six contractors' dump cars and dinkey. Give particulars. Box 313, Contract Record, Toronto, Ont. 6-7

Township of Brantford

Fonger and Barton Bridges

Sealed tenders, clearly endorsed on the outside, will be received up to noon on **Saturday, February 26th, 1916**, addressed to the Township Clerk, County Building, Brantford.

"A"—For reinforced concrete abutments for Fonger Bridge, containing 225 cubic yards of concrete, and 18,000 lbs. square cold twisted steel reinforcement.

"B"—For steel superstructure, Class "A" loading, clear waterway 70 feet, clear roadway 16 feet, with reinforced concrete deck and latticed hand-railings.

"C"—For reinforced concrete abutments for Barton Bridge, containing 165 cubic yards of concrete and 11,500 lbs. square cold twisted steel reinforcement.

"D"—For steel superstructure, Class "A" loading, clear waterway 80 feet, clear roadway 16 feet, with reinforced concrete deck and three line pipe handrailing.

Each tender must be on the prescribed form and accompanied by a marked cheque for 5 per cent. of the amount of the tender, made payable to the Treasurer of the Township of Brantford.

Plans and specifications may be seen at the office of the undersigned, Room 4, Temple Building, Brantford, from whom tender forms may be had.

ALAN MAIR JACKSON,
6-7 Township Engineer.

POSITIONS VACANT

Wanted by large concern developing electric stoves and heaters, experienced man or school of science graduate to act as foreman or engineer. Further particulars, Box 326, Contract Record, Toronto, Ont. 7-7

AGENTS WANTED

Canadian sales agents wanted by large company manufacturing road making and contractors' machinery. Box 297, Contract Record and Engineering Review, Toronto, Ont. 4-7

Quarry Machinery For Sale

1—No. 6 Kennedy Crusher with extra shaft and head; capacity 50 to 80 tons per hour.
1—revolving screen.
1—main drive belt.
1—60-ft. elevator complete.

For particulars address Box 311, Contract Record, Toronto, Ont. 6-7

Fires

Cape Spencer, N .B.

The oil warehouse and fog alarm, belonging to the Dominion Department of Marine & Fisheries, Ottawa, has been totally destroyed by fire. Loss, $6,000.

Roebuck, Ont.

The Roebuck Cheese & Butter Factory has been completely destroyed by fire. Loss, $10.000; insurance, $5,500. Proprietor, F. Lindsay.

Smith's Falls, Ont.

The Elgin Ward School has been entirely destroyed by fire. Loss, $25,000; insurance, $16,000. Secretary to the School Board, C. T. McBride.

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Alphabetical Index of Advertisers Page 16

Vol. 30 February 23, 1916 No. 8

Principal Contents

Constitution of Portland Cement

THE chemical constitution of Portland cement, which up to the present time has been more or less of a conjecture, may now be said to have been fairly definitely ascertained. This subject is treated in a very comprehensive way in a paper printed elsewhere in this issue on the subject of "The Chemistry of Portland Cement," by G. A. Rankin, in which he gives the results of his researches on the constitution of cement and the various cementing values of the different constituents. In view of the increasing use of concrete in modern construction and the demand for improved quality which has been brought about in the past, chiefly through perfection of mechanical contrivances and methods employed rather than by any new ideas based on a knowledge of the chemical constituents, further progress and development may be confidently looked for.

Portland cement clinker is the result of chemical combination of the oxides lime, alumina, and silica, with a small percentage of magnesia and ferric oxide. The mixture of these substances, which have very similar properties, is exceedingly fine grained, and it is consequently a very difficult matter to make a quantitative analysis of the constituents. This problem was approached by Mr. Rankin through synthetic treatment of the oxides CaO, Al_2O_3, SiO_2. Heat treatments and microscopic examinations were made to the number of some 7,000 readings on mixtures of these three oxides to ascertain the melting temperature and optical properties of compounds of lime, alumina, silica which form when various mixtures of these three oxides are heated. The data thus obtained is plotted in three dimensions, the concentration of each mixture is represented by a point within an equilateral triangle on the horizontal plane and the magnitude of the temperature by the distance above this plane; the surface thus described represents the melting temperatures of all products obtained when any mixture of the three oxides is heated higher and higher.

The constituents of Portland cement clinker made up only of the pure oxides CaO, Al_2O_3, SiO_2 are the compounds $CaO.SiO_2$ and $CaO.Al_2O_3$; microscopic examinations show that 90 per cent. of Portland cement is composed of these constituents.

The value of Portland cement as a cementing material when mixed with water is largely due to one or other of these compounds. The mixture of these pure oxides when properly burned will produce good Portland cement, with the rapidity of the reactions depending on temperature and the amount of flux formed at that temperature. The requisite amount of flux depends on the fineness of the materials; the finer they are ground the more readily will they combine. In commercial cement there is nearly always present small amounts of magnesia and ferric oxide, alkalies, etc., which have but little effect on the major constituents, but in burning play an important part in causing the formation of a flux at a much lower temperature, thereby accelerating the combination of CaO with Al_2O_3 and SiO_2.

Good Portland cement necessitates that the materials be properly ground, and heated sufficiently high, to complete the chemical reaction. Experience shows that cements containing any free lime are unsound and will in time disintegrate, due to the expansion of the free or unbound lime which reacts with water to form calcium hydrate. The value of Portland cement depends upon the fact that when finely powdered and mixed with water it forms a hard mass; the strength and permanence of this mass depend upon the constituents of the cement. Of these constituents, the compound tricalcium silicate, $3CaO.SiO_2$, is the one which hardens and develops the greatest strength within a reasonable time. It may be said, therefore, that the essential process for the manufacture of Portland cement is the formation of this compound, and that any improvements in the process yielding an increased percentage of this compound will increase the cementing value of Portland cement.

Canadian International Roads Congress

A preliminary programme of the Third Canadian and International Roads Congress, to be held in Montreal, March 6-10, is now made public. The subjects of the papers cover a very wide range, all of course dealing with good roads and to be presented by men who are experts in their respective fields. There will be papers on the construction of roads, methods, maintenance, bridges, machinery, materials, how to successfully meet difficulties of various kinds, etc. Many of the speakers will be practical men, who have had to solve problems either of construction or maintenance.

The Lieut.-Governor of Quebec has promised to open the Congress, and invitations have been forwarded to many prominent men associated with the good roads movement. The following are some of the speakers and their subjects: Messrs. Gabriel Henry, chief engineer, Province of Quebec, "Gravel and Stone Roads"; E. Farfard, chief of equipment department, Province of Quebec, "Handling and Care of Machinery"; Alex. Fraser, engineer, roads department, Province of Quebec, "Highway Culverts"; J. W. Levesque, M.L.A., "Road Laws"; A. F. Macallum, city engineer, Hamilton, Ont., "Creosoted Wood Block Pavements"; J. Duchastel, engineer, City of Outremont, P. Q., "Brick Highways and Streets"; W. Huber, engineer, Ontario Highways Department, "Maintenance Systems"; W. H. Connell, chief of the bureau of highways, Philadelphia, "Maintenance Materials and Methods"; Frank Smith, consulting engineer, New York, "Bituminous Macadam, hot mix, using asphaltic binder"; Prof. A. H. Blanchard, Columbia University, N. Y., "Bituminous Macadam, hot mix and penetration methods using tar binder"; Major W. W. Crosby, Baltimore, "Drainage and Foundations"; Elmer Thomson, Auto Club of America, "Motor Traffic, its trend and effect"; Col. W. A. Sawyer, chairman of the Massachusetts Highways Commission, "Different Types of Development used under various traffic conditions."

One of the subjects to be discussed will be the construction of an Imperial Highway as a memorial to the Canadian soldiers who are fighting overseas, while a resolution on the subject of the necessity of a uniform system of road maintenance will be brought forward. Delegates from the East will be interested in the discussion of a proposed highway from Quebec to Campbellton, and in the opening up of a new road between Ste. Agathe des Monts and St. Donat de Montcalm.

The Significance of "Graphs"

As civilization advances there is, from time to time, vividly brought to the attention of engineers the constantly increasing volume of comparative figures and general data of a scientific, technical, and statistical nature; and the need of a coherent and concise means of arranging this enormous mass of information in a form which will enable the average individual to recognize the salient features of these facts and which will serve as a guide in making correct deductions instead of accepting ready-made conclusions is increasingly evident. One of the most valuable instruments in the hands of the man who desires to boil an amount of information down to a point where its import can be gathered at a glance or be understood by minds which have not been specially trained to grasp the significance of figures is a simple and convenient system of charts, curves and graphs.

Mr. F. H. Martin, in his talk before the Manitoba Branch of the Canadian Society of Civil Engineers, printed in this issue, discussed at some length the value of such a system to the engineering profession. According to Mr. Martin, graphs are merely a "picturization of facts"—that is, statements or results are represented by diagrams or figures to picture or convey information in a vivid and instructive manner. Charts may be classified as "maps of results or facts," and statistics as "a collection of numerically tabulated facts."

The graphical analysis of all these results and facts gives a much clearer insight into their value and allows the average individual to apply them to the solution of what would otherwise appear to be complex problems. Mr. Martin will, in a later issue, discuss the mathematical phase of this system.

Large Expenditures on Toronto Schools

The management committee of the Board of Education of the city of Toronto have decided to recommend the expenditure of some $600,000 in providing a new high school and making necessary additions to many public schools at various points in the city where the overcrowding situation has become acute. The committee feel that this is the smallest possible sum that will be needed unless the work of the Board in providing adequate facilities for the school-children of the city is to be hampered. The chief item of expenditure will be a new central collegiate to be built on Bloor Street east, opposite St. Paul's new Anglican church, and which will take the place of the present Jarvis Street Collegiate; the cost of this building is placed at $250,000. The balance of the money will be spent on adding fifty-six additional class-rooms at an estimated cost of $6,000 per room; equipment will also be added to a number of the schools for domestic science and manual training.

Montreal Brickmakers Encouraged

The Financial Times prints an encouraging article on the attitude of Montreal brickmakers toward the outlook for the coming season. Building possibilities in and around Montreal show indication of a healthy recovery, though a fly in the ointment is likely to be the shortage of skilled labor. The general feeling is that the trade has reached rock bottom, and that the accumulated building which has been delayed must, some of it at least, be proceeded with during 1916. It is felt that many fine residences will probably be undertaken by men who have made money through munition orders of various kinds, and these represent no small proportion of the population of the city. The article closes: "Already the Street hears of some very large undertakings for the coming season. It is stated that the Imperial Oil Company will build a mammoth plant at Longue Pointe. Contracts are understood to have been let for the building of the new St. Maurice paper plant below Three Rivers, Que. This week the Government announcement was made that the Imperial Munitions Board had selected a site in Verdun for a $325,000 shell and fuse plant. The next six weeks will probably see the start of other notable building enterprises, though for the most part, as yet, it must be admitted that the architects' offices are practically idle."

Edmonton Branch C. S. C. E.

The Edmonton Branch Canadian Society of Civil Engineers had the pleasure of entertaining Mr. F. C. Gamble, Engineer of Railways for the British Columbia Government and immediate past president of the Canadian Society of Civil Engineers, at a dinner given in his honour at the Macdonald Hotel on the 9th instant. Mr. Gamble was stopping over in Edmonton a few days en route to Victoria, B. C., from Montreal, where he has been attending the Annual Meeting of the Society. The branch chairman, Mr. A. T. Fraser, District Engineer of the Canadian Northern Railway, presided at the dinner, which was attended by about twenty members of the Society resident in Edmonton.

Large Sum for Roadways

A committee of the York County Council have recommended to the Council the improvement of 210 miles of roads at a cost of some $750,000. The roads affected by the improvements are known as "Vaughan, Weston and Kennedy roads, and Yonge street, all running north and south.

This is the most comprehensive scheme drawn up since the good roads legislation was passed by the Ontario Legislature. In view of the heavy war expenditure placed on the county this year, the committee will recommend only a beginning in 1916. The road dealt with is likely to be that portion of Yonge street lying between Toronto and Lake Simcoe.

Discuss Elevator Construction

The Calgary Branch of the Canadian Society of Civil Engineers held its second dinner of the season at the Alexandra Hotel at 6.30 p. m., February 3, 1916. About 70 members and guests were present. After the dinner Mr. C. D. Howe, Chief Engineer, Dominion Government Grain Commission, addressed the Society on the subject of "Government Elevator Construction." His address was fully illustrated with lantern slides. It was listened to with much interest by the members present and a general discussion followed. The Calgary Branch expects to be favored with an address by Mr. J. G. Sullivan, Chief Engineer, Canadian Pacific Railway Company, on the Rogers Pass Tunnel, at an early date.

Fireproof Building Materials

Municipal authorities in Colon, Republic of Panama, have established a strict supervision over the building materials used in rebuilding and repairing the areas devastated by fire in the early summer. Colon, since it was first founded, has been built almost exclusively of highly inflammable materials and devastating fires have marked the years as it grew. Only four years ago one of these, more virulent than the rest, ate through the heart of the city, and again last spring another conflagration reduced nearly the entire city to a heap of ashes. At last the authorities have taken stringent measures to obviate the necessity for periodic re-building of the city. As a result the products which meet the stringent requirements set up by the authorities are doing a maximum business and among these are the H. W. Johns-Manville Company, who report that they were deluged with requests for immediate delivery. Orders for four car-load lots of the corrugated asbestos roofing alone, shipment from factory to be made within ten days receipt of the order, were accepted by the company on the spot.

Canadian Society of Civil Engineers

At a special meeting of the Toronto Branch held on Friday, February 18th, the subject of the reorganization committee was again discussed. Two of the nominees chosen at the last meeting, Messrs. G. A. McCarty and J. R. W. Ambrose, withdrew their names, and Col. R. W. Leonard was nominated for the Committee. The nominations for this Committee now stand as follows:—Messrs. G. R. G. Conway, H. E. T. Haultain, J. G. G. Kerry, E. W. Oliver, of Toronto; A. F. Macallum of Hamilton; S. B. Clement, North Bay; and Col. R. W. Leonard of St. Catharines. Prof. C. H. McLeod, Montreal, Secretary of the Society, was present and gave a short address and answered several questions of interest to the members.

Why Not "Pebbles"?

If the crimes against concrete practice could be classified, no doubt the majority of them would be listed in the column set aside for faulty aggregates.

An examination of standard dictionaries, textbooks in which definitions of materials may be found, and of specifications, will show a wide variation of practice in defining sand, gravel and boulders. Some dictionaries define gravel as a material free from a content of rock particles below a certain dimension, while others consider such particles as in part composing gravel.

Definitions fail to be uniform in fixing a line of demarcation that limits particles of gravel to certain maximum and minimum sizes; also in suggesting the cleanliness and uniform grading that standard specifications recognize as essential to coarse aggregate for concrete work. Confusion of "authorities" allows gravel to consist of particles ranging from 1-10 of an inch in smallest dimension to rocks or boulders.

Specifications no doubt owe their existence to a necessity compelled by faulty and conflicting definitions; yet good as the best specifications are, they do not always impress concrete workers with the fact that "gravel" means something entirely different from ungraded material coming from a natural bank deposit.

There should be no excuse for variations of individual interpretations. But as such variations exist, there is urgent need that the idea of maximum and minimum sizes for the particles of coarse aggregate be, if possible, expressed by a word which will also suggest the necessity for preparing the material to insure cleanliness as well as uniform grading. One word seems to have been overlooked, a word which takes one away from the thought of fine material, suggests cleanliness, and conveys an idea of limitation as to maximum and minimum sizes.

Pebbles, in the minds of most people, are clean rock particles made so by attrition in streams or otherwise. If in specifying gravel as coarse aggregate, "pebbles" ranging from a certain minimum to a certain maximum were specified, the idea of cleanliness and freedom from particles below and above certain sizes would be implied at once. Such material being unobtainable in a natural deposit would necessarily have to be prepared by screening or washing, or both, thus rendering the material fit for use as coarse aggregate.

Why "gravel"? Why not "pebbles"?—Cement Worker.

The Chemistry of Portland Cement

A research to determine the Chemical Constitution and Best Method of Producion of this All-important Building Material

By G. A Rankin*

Portland cement is now amongst the most valuable of manufactured products, its aggregate value being probably only second to that of iron and steel. Forty years ago its use was limited and it was manufactured on only a small scale; at the present time its use is so widespread that the annual production in this country alone is about 100,000,000 barrels. The chief use of Portland cement is as a substitute for stone. In some respects, concrete is superior to stone as a building material but under many conditions it is not so durable as the best building stone. There is reason to believe, however, that it may be possible to produce a cement which will yield a concrete of much greater durability than the Portland cement now made does. Indeed, as the demand for Portland cement has increased and as the requirements of engineers have called for material of better quality, the manufacturers have been able to meet these demands and to improve continuously the quality of their product. Now, it is to be noted that this continuous improvement has been brought about almost entirely by improvements in the mechanical appliances and methods of the industry, and owes very little to new ideas of how to make Portland cement based on a knowledge of what the constitution of the product really is.

Constitution of Portland Cement

The following pages present the results of an investigation of the constitution of Portland cement clinker and of the cementing value of the several constituents; these results enable us to indicate the nature and direction of the research work now required to ascertain the composition and best mode of production, of the cementing material best adapted to any particular purpose.

Portland cement clinker is the result of chemical combinations of the three oxides, lime, alumina, silica; but beside these three—which are the essential components—two others, namely, magnesia and ferric oxide, occur to some extent in commercial cement. The average of a large number of chemical analyses of American-made Portland cement is, according to Meade,

CaO	62.0 per cent.	Fe_2O_3	2.5 per cent.
Al_2O_3	7.5 per cent.	MgO	2.5 per cent.
SiO_2	22.0 per cent.	SO_3	1.5 per cent.

From this it is evident that more than 90 per cent. of an average Portland cement consists of the three oxides, CaO, Al_2O_3, SiO_2; one would expect, therefore, that its properties are due mainly to the presence of the above three components and that the relatively small admixture of the other oxides exerts at most a wholly secondary influence. Indeed, it has been shown that good Portland cement can be made from the three pure oxides, lime, alumina and silica, in the proper proportions.

Now, ordinary chemical methods enable us to ascertain the aggregate proportion of each oxide present, but they yield us no information as to the manner in which these oxides are combined with one another—in other words, as to the substances which actually are present in the clinker and are responsible for its characteristic properties. The determination of this question is very important, for this reason; that, until we know what these substances actually are, we cannot hope to improve the method of making Portland cement, or to improve the quality in any desired direction, except by cut-and-try methods; and it is generally recognized that such empirical methods are much less certain, and take a vastly longer time to reach the goal. than methods based on a real knowledge of the factors in the problem. The determination of this question has been the object of a very large number of investigations; but the experimental basis of most of this work has been altogether insufficient to decide the several questions at issue. There has been, in general, a failure to realize the fact that a system so complicated as this can be solved only by proceeding systematically, using as a guide the principle known as the phrase rule and establishing definite criteria for the recognition of the several substances which occur.

Cement Clinker

Cement clinker is a mixture of substances of very similar properties, and is, moreover, exceedingly fine grained, as a consequence of which it is a matter of some difficulty to make quantitative determination of the constituents; but this difficulty can be surmounted by studying separately each of the presumable constituents of the clinker and determining definite values of certain properties which serve to characterize it and to distinguish it from other possible constituents. Accordingly the first problem is to isolate and determine all the possible compounds of lime, alumina and silica which we may expect to find in Portland Cement clinker, to establish their relations at high temperatures and to ascertain their optical characteristics which constitute the most convenient and satisfactory criterion of the identity of the several substances.

These characteristic properties of the several solid substances, containing only CaO, Al_2O_3, SiO_2, which are likely to occur in Portland cement have been determined at the Geophysical Laboratory of the Carnegie Institution of Washington in the course of a systematic investigation of all compounds formed when any mixture of these oxides is heated to a high temperature. In American-made Portland cements the relative proportions of these oxides vary only between comparatively narrow limits: CaO-60 to 64; Al_2O_3-5 to 9; SiO_2-19 to 25; in other words, in considering this special problem we have to deal with a very restricted portion of the field of the whole system CaO-Al_2O_3-SiO_2.

The Ternary System CaO-Al_2O_3-SiO_2.

In order to work out this system completely it proved necessary to investigate about 1,000 different mixtures of these three oxides and to make about 7,000 heat treatments and microscopical examinations of the resultant products. Each such mixture, which was always made up of especially pure materials, was alternately fused and ground to a fine powder, the fusions being made in a platinum crucible to avoid con-

*Before American Concrete Institute Convention.

tamination, in order to obtain a thoroughly combined product. Each of these products was heated in an electric furnace, the temperature of which was carefully controlled and measured, until all changes had ceased, when it was quickly chilled; and the resultant material was subjected to a complete optical study. This procedure, which was carried out systematically,

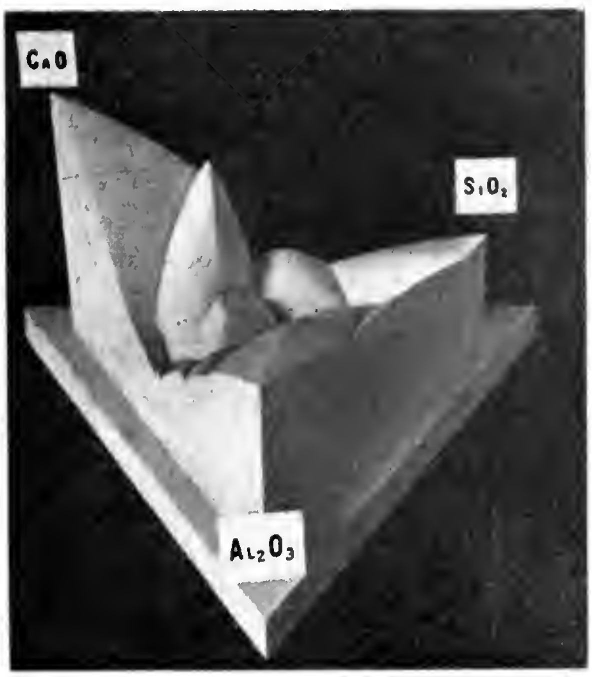


Fig. 1—A Model of the Concentration-Temperatures by the Ternary System.

enables one to determine the crystalline phases present at temperatures ranging from that at which melting begins to that at which the charge is completely melted; and thus to ascertain the melting temperature and optical properties of all compounds of lime, alumina, silica which form when any mixture of these three oxides is heated.

Data Plotted

The data thus obtained can be interpreted most readily if they are plotted in three dimensions; the concentration (composition) of each mixture is represented by a point within an equilateral triangle* on the horizontal plane, the magnitude of the corresponding temperature by the distance above this plane. It would lead us too far to go into details of the construction and properties of such a model; suffice it to say that the series of surfaces thus described represent the melting temperatures of all products obtained when any mixture of the three oxides is heated progressively to higher and higher temperature. A photograph of such a model is reproduced in Fig. 1. As can be seen from the photograph, the model resembles a relief map of a mountainous region: each mountain peak is the melting point of a pure component or of a pure compound; the mountain slopes represent the melting temperatures of a component or compound in ternary mixtures; the points where the rivers in the valleys meet to form a lake are the lowest melting temperatures, known as eutectic points. This model, when interpreted with the aid of the principles underlying such equilibria, enables one to specify the order in which the several crystalline substances will form when any mixture composed entirely of lime, alumina and silica is heated, and also to state what are the final products when the reactions have gone to completion.

Let us consider the crystalline substances which will form when a mixture composed only of these three oxides in the proportions such that they will produce a good Portland cement, is heated. For this purpose a diagram such as Fig. 2 is useful. This diagram is a projection on the horizontal plane of that portion of the solid model necessary for our present purpose. The corresponding temperatures are here represented by isothermal lines, which are completely analogous to the contour lines on an ordinary map. In this diagram the group of dots represents mixtures of CaO, Al$_2$O$_3$, SiO$_2$ from which Portland cement of good quality can be made.

This group of dots, it will be noted, are all included within the triangular area formed by lines connecting the compositions of the three compounds, tricalcium silicate, dicalcium silicate and tricalcium aluminate. For that reason, if any mixture of CaO, Al$_2$O$_3$ and SiO$_2$, such as is represented by one of these dots, is heated so that all chemical reactions are completed, the final product obtained will be made up of the above three compounds.

Characteristics of Constituents

The constituents of Portland cement clinker made up only of the oxides CaO, Al$_2$O$_3$, SiO$_2$ are therefore the three compounds 3CaO.SiO$_2$, 2CaO.SiO$_2$ and 3CaO.Al$_2$O$_3$. Each of these compounds has optical properties peculiar to itself which serve to distinguish it from the rest. The several characteristic optical and crystalligraphical properties were obtained by a study of each compound itself. These values are constants for the individual compounds in all mixtures made up from pure CaO, Al$_2$O$_3$ and SiO$_2$; i. e., the

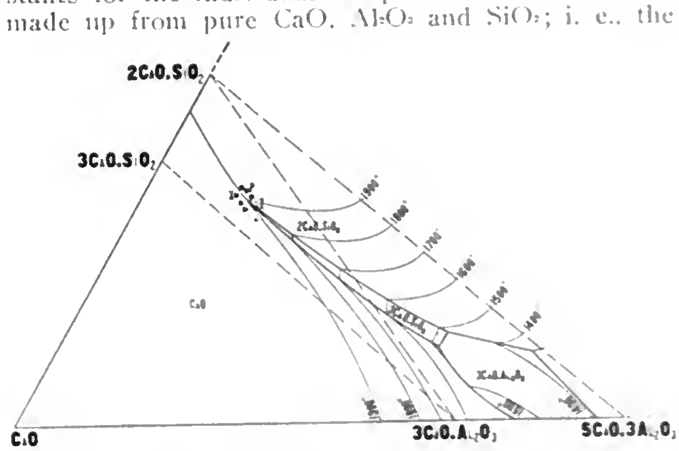


FIG. 2.—PROJECTION OF A PORTION OF CONCENTRATION-TEMPERATURES OF TERNARY SYSTEM CaO-Al$_2$O$_3$-SiO$_2$ WITH ISOTHERMALS.

The dots represent the mixtures of CaO, Al$_2$O$_3$ and SiO$_2$ from which Portland cement of good quality can be made

final products resulting when such mixtures are heated, are present as individuals of constant optical properties and not as solid solutions.

Microscopical examination of commercial Portland cement clinker shows it to be made up largely (over 90 per cent.) of these three compounds 2CaO.SiO$_2$, 3CaO.SiO$_2$ and 3CaO.Al$_2$O$_3$. It would appear, therefore, that the value of Portland cement as a cementing material when mixed with water is largely due to one or more of these compounds. Before taking up the cementing value of each of these compounds, however,

*In such a diagram, the pure components CaO, Al$_2$O$_3$, SiO$_2$, are represented by the apices of the triangle; the binary system, CaO-Al$_2$O$_3$, CaO-SiO$_2$ and Al$_2$O$_3$-SiO$_2$, by the sides of the triangle, and ternary mixtures by points within the triangle.

let us consider their formation when Portland cement is burned.

Chemical Reactions

For this purpose let us follow the reactions which take place when a mixture whose composition is CaO (as $CaCO_3$) 68.4 per cent., Al_2O_3 8.0 per cent., SiO_2 23.6 per cent. (point P, Fig. 2), is slowly heated. This mixture, made up only of the pure oxides, lime, alumina, silica, when properly burned, will produce a good Portland cement. When such a mixture is heated, the first change is the evolution of the CO_2; the lime then unites with the other components to form the compounds $5CaO.3Al_2O_3$ and $2CaO.SiO_2$ (both of which form readily) probably in the order named, since the former has a lower melting point than the latter; subsequently these two compounds unite in part with more lime and the compounds $3CaO.SiO_2$ and $3CaO.Al_2O_3$ appear. This formation of the last two compounds—a process which goes on very slowly in mixtures of their own composition—is materially facilitated by the circumstance that in the ternary mixtures a portion of the charge has already melted and promotes reaction by acting as a flux or solvent. The temperature at which this flux first appears is 1335 degrees C.. the eutectic temperature for the three compounds $2CaO.SiO_2$, $5CaO.3Al_2O_3$, $3CaO.Al_2O_3$. As the temperature of burning gradually rises above 1335 degrees, the relative amount of flux increases and the rate of formation of $3CaO.Al_2O_3$ and $3CaO.SiO_2$ increases correspondingly. At a temperature somewhat above 1335 degrees the compound $5CaO.3Al_2O_3$ will have completely melted in the flux and the formation of $3CaO.Al_2O_3$ is complete. The substances present as crystals at this stage are $3CaO.SiO_2$, $3CaO.Al_2O_3$, $2CaO.SiO_2$ and free CaO. Of these the $3CaO.SiO_2$ is rapidly increasing in amount, due to combination of $2CaO.SiO_2$ with CaO, while the amounts of solid $2CaO.SiO_2$, CaO and $3CaO.Al_2O_3$ are all decreasing, the $2CaO.SiO_2$ partially by combination with CaO and partially by dissolving along with $3CaO.Al_2O_3$ in the flux. As the temperature is raised still further, the amount of flux (liquid) increases and the rate of combination of CaO with $2CaO.SiO_2$ to form $3CaO.SiO_2$ increases. But it is not necessary to raise the temperature until the charge is completely melted, as normal cement clinker is obtained at temperatures much below complete melting; in other words, the necessary reactions will go to completion below the temperature required for complete melting. The rapidity with which the reactions go to completion is governed by the temperature and by the amount of flux formed at that temperature. The requisite amount of flux in turn depends upon the fineness of the raw materials, since the finer these materials are ground the more readily the components will combine. For finely ground raw materials of the above composition, composed only of CaO, Al_2O_3, SiO_2, a temperature of about 1650 degrees C. is required for burning. At this temperature the clinker would be about 30 per cent. melted and 70 per cent. solid crystalline material. a proportion of flux which would admit of the necessary reactions going to completion in a reasonable time. The charge will always completely crystallize on cooling; the percentage composition (based on actual data) of the clinker thus obtained would be approximately $3CaO.SiO_2$. 45 per cent.; $2CaO.SiO_2$, 35 per cent.; and $3CaO.Al_2O_3$, 20 per cent. The melting temperature of the flux necessary for the production of the clinker is materially lowered by the pressure of small amounts of impurities; that the small amounts of Fe_2O_3, MgO, etc., in commercial cement actually have this effect is shown by the fact that the temperature required for burning is about 1425 degrees C.

Table I.—Compositions and Burnino Temperatures of Various Portland Cements.[1]

Percentage Composition of Clinker.

Portland Cements	Actual Components.	Relative to Content of $CaO\text{-}Al_2O_3\text{-}SiO_2$.	Burning Temperature, Deg. C.	Constituents of Resulting Cements.
Pure (P)	CaO .... 68.4 Al_2O_3 .... 6.0 SiO_2 .... 23.6 } 100.0	CaO ... 68.4 Al_2O_3 .. 8.0 SiO_2 ... 23.6	1650	$2CaO.SiO_2$ $3CaO.SiO_2$ $3CaO.Al_2O_3$
White (A)	CaO .... 66.2 Al_2O_3 .... 6.4 SiO_2 .... 25.0 } 97.6 MgO, Fe_2O_3, Na_2O and K_2O 2.4	CaO ... 67.9 Al_2O_3 .. 6.5 SiO_2 ... 25.6	1525	$2CaO.SiO_2$ $3CaO.SiO_2$ $3CaO.Al_2O_3$ } Small amount of CaO.
Gray (B)	CaO .... 63.2 Al_2O_3 .... 7.7 SiO_2 .... 22.4 } 93.3 MgO, Fe_2O_3, Na_2O, K_2O and SO_3 .... 6.7	CaO ... 66.7 Al_2O_3 .. 9.0 SiO_2 ... 24.3	1425	$2CaO.SiO_2$ $3CaO.SiO_2$ $3CaO.Al_2O_3$ } Small amounts of $5CaO.3Al_2O_3CaO$ and ferrites.

[1] The data given in this table are based largely on the work of this laboratory. The analyses of commercial clinkers are from publications from the Bureau of Standards and from "Portland Cement," by R. K. Meade. The temperatures of burning and the constituents given are based both on our work and that of the Bureau of Standards.

In the foregoing discussion, we have followed to completion the course of the reactions which take place when cement clinker composed of pure CaO, Al_2O_3, SiO_2, is burned; in other words, we have shown the formation of the compounds during the burning of mixtures of these three oxides in the proper proportions for cement clinker, and stated what compounds will be present in the final product if the burning is continued long enough and at a sufficiently high temperature.

This description of the essential reactions which take place when cement made up only of CaO, Al_2O_3, SiO_2 is burned, applies equally well to commercial Portland cement. In commercial cements, however, there is always present small amounts of Fe_2O_3, MgO. alkalies, etc. These minor components. which total less than 10 per cent., have but little effect on the major constituents of the clinker. During the burning of cement clinker, however, these minor components play an important part, since their presence ensures the formation of a flux at a much lower temperature, and thereby materially promotes the combination of CaO with Al_2O_3 and SiO_2.

Burning Temperatures

In order to afford a comparison of the chemical compositions, the temperature required for burning and the final products obtained for different types of Portland cement, the necessary data have been collated in Table I. The examples given in this table are based on the average for a large number of analyses of each of three types of Portland cement, viz., pure cement, made only of CaO, Al_2O_3, SiO_2; commercial white cement; and the more common gray variety of Portland cement.

If the raw material for pure cement is perfectly burned at a temperature of 1650 degrees, the clinker obtained will consist of the three compounds—orthosilicate of lime, tricalcic silicate, and tricalcic aluminate. The example of a pure cement, given in Table I. has the chemical composition 68.4 per cent. lime, 8.0 per cent alumina, 23.6 per cent. silica. The raw material for white commercial cement, when burned at a temperature of 1525 degrees. will produce a clinker which consists largely of the same three compounds found in pure clinker, except for a small amount of free lime. The average chemical composition of this type of cement as given in the table is 66.2 per cent. lime, 6.4 per cent. alumina, 25 per cent. silica, and 2.4 per cent. magnesia, iron oxide and alkali. The clinker obtained on burning the raw material for commercial gray cement at 1425 degrees will consist largely of the same three compounds found in the other two types of clinker, except for small amounts of free lime, the compound $5CaO.3Al_2O_3$, and iron oxide as ferrites. The composition of this clinker is 63.2 per cent. lime, 7.7 per cent. alumina, 22.4 per cent silica, 6.7 per cent MgO, Fe_2O_3, alkali and SO_3.

(To be continued)

Cushions for Block Type Pavements

Introduction of Sand-Cement Cushion Due to the Need of Making the Cushion an Integral Part of the Pavement

By Maurice B Greenough*

The word cushion is defined as anything introduced to relieve the shock or jar between parts. Its use in paving practice represents the application of a word which was originally of popular significance only to a highly specialized engineering function. As used in highway practice, then, a cushion is that material introduced between the bottom of the wearing surface and the top of the artificial base in pavements whose surface is of a type represented by wood, asphalt, brick, or stone block. The nature of the filling material between individual blocks has no bearing upon the use of the term, but serves to accentuate some of the properties ascribed to the cushion. According to the definition and to accepted practice, the primary function of the cushion in pavements of the block type is to relieve the shock of moving loads on the surface of the pavement. Other functions may be attributed to the cushion; to provide a firm and uniform support for individual blocks; to compensate for irregularities in the surface of either the base or the blocks composing the surface, and finally to transmit the effects of surface loads to the artificial base with a uniform distribution of intensity.

Sand Cushion

A variety of materials have been used for cushions at one time or another, but sand alone or in combination with other materials has enjoyed the widest application for this purpose. Local availability of stone dust or granulated slag has determined their use in a number of instances, but stone dust is similar to sand in its physical characteristics and properties and granulated slag may approach a condition similar to that obtained by the use of cement in the cushion. Bituminous materials have been used to some extent, particularly in wood block construction, but more for the purpose of waterproofing the bottom of the blocks than for providing an elastic cushion.

Sand-Cement Mixtures

Wood block pavements have been laid upon a sand cushion for many years, but within the last decade a mixture of sand and cement has superseded plain sand to a large extent. Asphalt blocks have been laid upon a sand-cement cushion through the necessity of providing a firm and uniform support for blocks having so large an exposed area in proportion to the depth. Up to 1913, sand was almost universally used as the cushion material for both brick and stone block pavements, and it is only since that time that sand-cement mixtures have been employed to any great extent, and in some cases that it has been dispensed with entirely.

Greater Intimacy

During the time that cushions have been in use there have been two important and indicative tendencies developing that are worthy of attention. They are, the increasing emphasis laid upon the necessity of securing a uniformly dense degree of compactness, and the gradual reduction of cushion thickness. The origin of both these tendencies lies in a desire to obtain greater intimacy between individual grains in the cushion and between the surface and base of the pavement as a whole. An unconfined mass of sand cannot be said to possess elasticity, the property which must be developed to make a satisfactory cushion. The minimum elasticity of sand exists when a multitude of particles are in the free state and the maximum obtains when those particles are bonded in the form of sandstone or even pure quartz. Therefore, we may say that the degree of elasticity that can be developed by sand is directly proportional to the intimacy of contact between individual grains or to the extent of its confinement. It is true that each grain may possess elasticity, but it may be overshadowed and rendered unavailable by the lack of intimate contact. Most specifications for sand cushions seek to secure maximum density by laying stress upon spreading and rolling, irrespective of any consideration as to the possibility of ever producing a dense cushion with any amount of rolling in view of the granulometric composition of the sand.

Depth of Cushion

In early practice, cushions for both brick and stone block pavements were as deep as three inches. There has been a gradual reduction in depth until now we find most brick pavements laid upon cushions from 1 to 1½ inches deep, and cushions for stone block pavements are usually limited to a maximum of two inches. Where sand is still used as the cushion material for wood block pavements, one inch is the common depth. One-half an inch is the customary depth for the mortar cushion of wood and asphalt block pavements. Doubtless the reduction in thickness of pavement cushions has been brought about, in part, by smoother surfaced concrete bases. The intricacy of the cushion problem depends upon the nature of the joint filler in the pavement surface. If the individual blocks composing the surface are free to move without affecting their neighbors, the effect of surface loading is localized to that portion of the cushion underlying each block. It is only when the blocks in the surface are bonded to form a monolithic slab that the elastic function of the cushion reaches its maximum importance.

*Presented before section D of the American Association for the Advancement of Science at the Columbus meeting.

and it is in this connection that so much discussion has recently arisen.

Pavements as Engineering Structures

The time has come when we should look upon a pavement as an engineering structure and approach its problems from the same angle that we approach other engineering problems, namely by methods of exact analysis, based upon the fundamental laws of mechanics. That the problems of pavements are more complex than those of other engineering structures does not prevent the possibilities of an ultimate solution. This complexity of elements has simply inhibited the development of an exact analysis, not prevented it. The stresses to which pavements are subjected arise from two sources, the loads of traffic and thermal changes. Under the latter may be grouped all the stresses which are due to thermal conditions accentuated by the presence of moisture. Stresses may be set up at any time which arise from a single source or they may be created by combined traffic and thermal forces. An analysis of pavement stresses predicated the fact that a structure is inherently weak whose component parts are not so arranged as to meet stresses from both sources in the most advantageous manner. For the purpose of analogy a pavement subjected to traffic load may be compared to an arch composed of metal plates connected by rivets. In this case, the plates are subjected to direct tension, compression, or shear; the rivets are subjected to bending and shear. In this analogy, the grout between individual blocks may be compared to rivets, whose function it is to transmit the stress from one unit to another. While the rivets may be subjected to a true bending stress in the transmission of stress between plates, the grout between blocks in a pavement does not carry direct bending, since the flexure of a pavement surface produces compression in the joints above the neutral axis and tension below. It is further called upon to resist the impact of moving loads upon each block which introduces the element of shear.

Foundation Support

An incident came to the attention of the writer recently in which the rear wheels of a loaded truck weighing about twelve tons, proceeding at a rate of about eight miles an hour, broke through the surface of a four-inch cement grouted brick pavement laid upon a natural earth foundation, brought about probably by lack of foundation support. The accident served to confirm an opinion that we are working with a very narrow margin of safety in our grouted block pavements as far as shearing resistance is concerned, in view of the fact that we cannot always be sure of adequate support for pavement surfaces.

A series of experiments conducted at Case School of Applied Science showed that the ultimate shearing resistance of a four-inch brick perfectly grouted with a 1:1 mixture of sand and cement is approximately 17,800 lbs. In the case of the truck mentioned we may assume that the load was distributed in the proportion of one-third to the forward axle and two-thirds to the rear axles, making the load upon one rear wheel about 8,000 lbs. The tires on the rear wheels of the truck were of the caterpillar type, so that it is reasonable to assume that the load would have been transmitted to individual blocks with impact. The pavement was quite smooth on the surface so that on the principle of mechanics that a suddenly applied load produces double the equivalent of a gradually applied load both in the load itself and in the intensity of the stress developed, the probable load exerted upon the blocks in this pavement was 16,000 lbs., as a minimum estimate. The ultimate load of 17,800 lbs. was obtained with a perfectly grouted joint, that may or may not have existed in the case under discussion.

Elastic Resistance

The logical conclusion to be drawn from this illustration is that unless the blocks in the surface of a grouted pavement are adequately supported, stresses may be set up in the joints far in excess of the safe limit. If the pavement is constructed with a cushion on an artificial base, it is the function of the cushion to provide such a support and to contribute its elastic resistance, both of which prevent an undue stressing of the joint filler. There is a limit to the elastic deformation that a pavement may undergo and retain its integrity.

Surface Deflection

The passage of a vehicle over a pavement produces a deflection in the surface which is distributed over a wide area. When the surface of a pavement is depressed by loads, the work performed in any given instance is the measure of the resiliency. When the internal stresses created are within the elastic limit of the structure, or within the range through which the deformation has a constant relation to the stress, the amount of the elastic energy stored and recoverable is equal to the resiliency. If, however, the elastic limit of the structure is exceeded, some of the applied energy is dissipated in the form of heat. In the former case, the structure will resume its normal position upon removal of the load, but in the latter there can be no recovery and there exists a permanent deformation.

Elasticity of the Structure

It must be remembered that in pavements of the block type, with the exception of wood and perhaps asphalt, the materials involved are only slightly elastic, and when combined in the form of a pavement, the elasticity of the structure as a whole depends upon the integrity of bond between the various elements. Therefore, it is essential that there should be a slight relief for applied loads, in order that the stresses created may build up slowly, otherwise the pavement may be subjected to stresses that are of double intensity due to impact alone, which may be augmented by further impact stresses caused by irregularities in the surface. We may say, then, that to successfully withstand heavy loads, the elastic properties of all the elements of the pavement should be brought into play, and to produce this condition the elements should act in harmony.

Cement-Cushion Inherently Stronger

Thus we find the introduction of the sand cement-cushion for block pavements to have been caused by a desire to make the cushion such an integral part of the pavement that there should be no chance of losing energy needed to successfully bear heavy moving loads. The presence of the cement assures a cushion of uniform density, and one that can perform all the functions ascribed to cushions in general, leaving nothing to chance. Not only is the cushion inherently stronger, but it stiffens the whole structure by its complete bond to the surface and the base. In such a pavement, the natural relief against suddenly applied loads is found in the sub-grade itself, and the possibilities that any one element of the structure will be overburdened are lessened.

Effect of "Roughs" on Brick Industry

Present stringent situation in the face-brick industry—Due to the temporary craze for rough-faced brick—Manufacturers to blame

By T. P. Cuthbert*

The vogue of rough texture brick, particularly during the last three years, has brought about an almost complete revolution in the business, and it is the object of this paper, by considering the effect that this change has had on the men who make and the men who sell face-brick, to cast a little light, if possible, on what we may expect from rough texture brick in the immediate future.

Who Started the Fashion?

Six or eight years ago we frequently heard the question asked—"Who started the use of rough texture brick?" I don't think that question has ever been satisfactorily answered, but we all know that it got its real start about that time and we know that a great deal of money was expended by both face-brick manufacturers and dealers everywhere in establishing this demand. And this was not alone through the use of printers' ink, but more particularly by dealers in the laying up of very elaborate panels of "rough brick" in their display rooms, each trying to outdo the other, and apparently with but small regard for expense.

The Additional Cost of Displays

The total amount expended in this way, owing to the frequent changes in displays necessitated by changes in the texture of brick, must have been enormous. And if we add to this the money that has been spent in laying up special panels of texture brick for the individual inspection of special customers, the total amount would actually run into the hundreds of thousands of dollars.

This practice I believe goes a long way toward explaining why few dealers have made satisfactory profits during recent years, and also why so many of the older and more conservative dealers, some of whom may be said to have fathered the face-brick business in this country, express dissatisfaction with present conditions, for there were no such extraordinary expenses connected with the sale of smooth face brick.

Six or eight years ago, when only "good" rough texture brick were made, when quality was considered rather than price, they were probably profitable to both manufacturer and dealer. Since then, while the cost of selling has steadily increased, both price and quality have come in a straight line downward, until the profits once made on these brick have reached or passed the vanishing point, and the price obtained for smooth face-brick has been pulled down, along with the price for roughs.

Expected by the Older Dealers

Is there anything surprising about present conditions? It would seem not. We are getting just exactly what we should have expected and what some of our oldest face-brick dealers actually anticipated. When you take a well made face-brick, wire-cut the face, scratch it up into a so-called rug or otherwise mutilate it, you destroy the very qualities that make it a face-brick; it loses its class, and becomes an absorbent dust and dirt catcher. While on the other hand, if a common brick is treated in a similar manner, its crudeness and the imperfections that identify it as a common-brick fit only for backing-up, are covered, and it is elevated to a point where "rough texture" face-brick and "rough texture" common-brick reach a common level, and where both sell (or soon will sell) for about the same price.

This means an extra profit for some of the scores of common-brick manufacturers, who have been boosted into the face-brick business by this craze for rough texture brick; but it spells nothing less than ruination for many of the best known men in the face-brick business—the "Fathers of the Industry."

By the roughening process, the improvements that have been made in face-brick during the last two generations, as well as the expensive equipment on many face-brick plants in all sections of the country, are neutralized and made of little or no account.

Demand for Face Brick Growing

Some have been inclined to explain these conditions by a general fall-off in the demand for face-brick, or to depressed general business conditions, but this is not correct; it is a fact that the percentage of buildings, particularly houses, in which face-brick have been used, has rapidly increased during recent years, and the demand for face-brick has shown a corresponding increase in spite of general business conditions.

Shipments of face-brick in this country have actually increased almost 33 per cent. during the last six years and the largest three years we ever had, with one single exception, have been the last three. Nor can we give rough texture brick the credit for being responsible for this increase, at the very largest year the face-brick business ever enjoyed was 1909, when rough texture brick made up a very insignificant part of the total.

Prices Dwindle in an Upward Market

The business of most face-brick manufacturers has shriveled up, not because of general business conditions, but because of the craze for rough texture brick. But this is not all of it—it is not even the worst of it. The average price of all legitimate face-brick made in this country, whether smooth or rough texture, has come in a straight line downward, purely and simply as the result of the influence rough texture brick have had on the business, and in spite of the fact that the price of practically every other manufactured article has gone in a constant, straight line upward.

The tendency of common-brick for the last six years has been upward, with prices at their very best during the last two years. The average price obtained for paving-brick for the last six years has increased constantly until the end of 1914, the increase from 1909 to 1914 being approximately thirty-two per cent., and 1914 was the best year in the history of the paving-brick industry.

While the price of everything else has gone up and is still going, the prices we have obtained for our product have been going down, and we have not the

* Before the American Face-Brick Association.

slightest reason for supposing that they have struck bottom.

Bad Business for the Industry

What excuse was there for this craze for "rough texture brick"? To my mind there was very little. We will all grant that there are certain jobs where rough brick seem to fit and with climatic and other conditions taken into consideration, they are a good business proposition for the home builder or investor. No one admires such buildings more than I, for even a log house, or a bungalow built of cobble-stones looks good in some locations—if the architecture fits the material. But we don't find the lumber dealers trying to create a foolish fad for log-houses.

In Pittsburgh a few years ago rough faced brick were used in a house on a shady avenue and immediately adjoining it the same builder also used smooth brick of the same shade. I saw these houses while they were going up and after they were finished, and it was almost impossible even for a man in the face-brick business to see any difference between the two brick, even from across the street. These houses are now about six years old—one job is of a greasy appearance and extremely dirty while the other presents almost exactly the same appearance as it did when finished. Cases that parallel this can be found in all sections of the country. It makes no difference whose rough texture brick is considered and it makes no difference whether they are made on common-brick plants or on face-brick plants, the story is the same; they get dirty, and if they are soiled and dirty at the end of a very few years what will happen to them in ten or twenty years?

How Many Manufacturers are Ahead

Leaving the future out of the question for the moment, how many face-brick manufacturers and dealers are ahead of the "rough brick" game? And, if we are not ahead of it now, what can we expect from it in the future, in view of present common-brick competition? We are making our rough face-brick in exactly the same textures as the common rough-brick makers, and some of us are paying 25c per M. for the privilege of doing it.

Do we have to stand for this common-brick competition? I think not, for there is still one kind of brick that common-brick manufacturers cannot imitate, and that is a good brick,—with a good, smooth face.

The Chicago Clay Show

About four years ago, practically every important manufacturer of face-brick was called upon to contribute to a fund for the making of elaborate brick displays in the Coliseum during the big clay show; in spite of the fact that most manufacturers were then chiefly interested in smooth face-brick, many factories making them exclusively, every important display of face-brick, including all of the prominent panels, all ornamental brick walls, gate ways, and even the "model" brick house, were laid up exclusively with rough texture brick; not a single important display of smooth face-brick was made. Practically all of the architects, builders, and dealers in face-brick in the Chicago district during, and for two or three years after the clay show, were rooting exclusively for rough texture brick. They and brick people elsewhere talked "art" in rough texture brick until they persuaded themselves that all of the art in architecture began and ended in wire cut face-brick.

And what was the result? They accomplished what seemed impossible and brought about a complete revolution in the face-brick business; and I know that I am not overstating the facts when I say that more, much more than seventy-five per cent. of all face-brick used in Chicago since the clay show have been roughs.

The Effect Upon Prices

Since the clay show, prices obtained for face-brick in the Chicago district have come tumbling down like a house of cards, and the quantities of legitimate face-brick that have been shipped into the Chicago district this year, whether rough or smooth, have been cut in half, the big half now going to the concerns who, previous to the clay show, were manufacturers of common-brick.

Have our friends the brick dealers been benefited by the craze for roughs? I am in a position to know that many of them have not, for I have discussed the matter with a great many dealers during the past few months. Many of them are old established concerns whose names are known to all of you, and they, without exception, have expressed dissatisfaction with the conditions that have been brought about by rough texture brick. Several of them expressed their intention of openly opposing the sale of rough texture brick this year, and of instructing their salesmen accordingly.

Can brick dealers bring their business back to the old footing by pushing the sale of smooth texture brick? I believe they can; in fact it has already been done in one of our largest cities.

The rough brick craze which started in Philadelphia was suddenly and effectually stopped, with the result that the average price now obtained for face-brick in that city is higher than in any other important eastern city, and the profit per M. is, also, correspondingly high.

What has been done in Philadelphia, can be done elsewhere. In sections where rough texture brick are the fad, the manufacturers and dealers started the demand by trimming their windows, so to speak, with rough texture brick. But no expensive displays would be necessary to bring smooth brick back to their former popularity, for a comparison drawn between smooth and rough texture brick walls which have been standing for a few years will serve all purposes most admirably.

Buildings Themselves the Best Arguments

The smooth face jobs have, for the most part, remained clean, but the rough texture jobs that have aged a little, now resemble autumn leaves grown old.

In my opinion one of the best ways to kill off common-brick competition is for manufacturers of face-brick, particularly manufacturers of red face-brick, to make smooth face-brick in all the varying shades in which they have been making rough face-brick, including the flashed brick with red cores and blue and brown edges and other markings, and for them to make them as smooth and perfect as possible.

Such a brick will lend itself to artistic bricklaying quite as well as a rough texture brick of the same shade. The principal difference between the two brick will be that the smooth brick will have a better and cleaner cut appearance in the wall.

A brick wall built of hard burned, smooth face-brick will stand the test of time and is the best possible advertisement for brick, just as the poorest possible advertisement is a brick job that is ruined by soot and dirt, as most of the rough brick jobs in the country will be in a mighty short time.

The Organization of a Maintenance and Repair System on Ontario Roads

By A. A. Smith

A valuable paper on the organization of a maintenance system was read by Mr. A. A. Smith before the recent Toronto Good Roads Conference. The following points from Mr. Smith's paper were unavoidably omitted from our last week's report of this Conference:

There is a wide distinction between Maintenance and Repair as applied to highway operations. The operations required to constantly oppose the deterioration of a completed road by the effect of traffic and climatic conditions, and to keep it as nearly as possible in its initial condition, constitute maintenance. Without maintenance, the road tends to deteriorate and the operations necessary to restore it constitute repairs. Both processes are often similar in kind and may even overlap. A well constructed road properly maintained should not need repair for some time, but a properly repaired road always needs maintenance.

All the railroads have adopted a strict maintenance system on their road-beds, bridges, culverts, etc., which has proven of the greatest value. This maintenance system should prove equally beneficial in the case of highways.

There are several schemes for highway maintenance that have been adopted. One is to assign to a certain individual a given length of road, credit him with a certain sum, and leave him to his own devices in its upkeep. This method does not usually give best results. Another method is to have one man over a larger area and give him sufficient means to maintain it. This man usually gets a gang of men and teams together and does his share all at once, when the farmers are slack—which again means that during the balance of the year, when traffic is heaviest, the road gets no attention at all. A third method is the patrol system, after the kind adopted in New York State which appears to be a most satisfactory method for maintaining roads. The patrol man, supplied with tools and machinery from the municipality, is employed continuously to maintain from five to ten miles of road. His work consists in preventing unnecessary deterioration of the road surface, in the removal of loose stone, the repair of the centre of the road due to the wear from horses' feet, sanding the road and supplying binder in wet weather to prevent ravelling, cleaning out gutters, culverts, catchbasins and waterways, lowering the shoulders of the road, repairing damages due to wash-outs and freshets on all slopes, and making any necessary repairs on wood floors of culverts and bridges. He should report once a week on the location and nature of each day's work to a highway foreman or inspector. This foreman should have sufficient knowledge and experience to justify spending his entire time in supervising, planning, and setting out the work. This foreman is given a certain area or section, for the maintenance of which he is held directly responsible. This area generally covers from sixty to one hundred miles of roadway, with from eight to ten patrol men under the foreman. The foreman shall not have the power to engage or discharge any patrol man without first reporting to the superintendent, but otherwise shall have full control over them. The foreman is required to report weekly to the superintendent on the work done, time spent, materials used, and the need of larger necessary repairs, such as resurfacing, rolling, oiling, and repairs to bridges, culverts, etc., which are to be done under the supervision of the superintendent.

The duties of the road superintendent in connection with road maintenance are similar to those of a municipal clerk,—reporting to and carrying out the instructions of the council. He shall attend all meetings of the council which relate to work carried out by him, and shall supervise all work and employ inspectors or foremen as may be required, who shall also be subject to dismissal by him. He shall employ and discharge any patrol men, teams, or laborers required to carry out the work, and purchase all necessary material and tools. He shall keep an accurate record of men and teams employed, work done, material used, and furnish an O. K. pay-sheet account to a proper committee for their approval before the municipal treasurer issues any checks in payment thereof. The superintendent must pay the foreman and men under him in accordance with the time sheets and obtain a receipt for the same.

One of the chief difficulties in the maintaining of macadam roads is, perhaps, ravelling of the stone in dry weather when the road has not sufficient binding material. One method of alleviating this trouble is, by sprinkling the road with water where water is convenient and plentiful, or by applying a thin coat of sharp clean sand or screenings thoroughly tamped. Another evil is the tendency for the road to rut, due to a greater wheel load than the road is capable of carrying, inferior binding material, and the tendency of a team to follow the wheel-tracks of the preceding vehicle. The best remedy for this is to loosen the stone in and around the depressions and fill them in with new material of the same size and quality, tamp well, leaving the surface slightly higher than the surrounding surface in order to allow for compaction.

Dust prevention is a necessity in prolonging the life of a macadam roadway. Dust can be overcome by watering, sweeping, or by the use of oil. Proper maintenance of a road cannot be carried out without the use of a roller. This should be used in the spring of the year, when the road is soft and pliable. Ditching is also a big item in maintenance work. All ditches need constant attention. They should be kept free from weeds, grass and rubbish, and given sufficient fall to carry water off immediately. This patrol system wherever used, has been found to give good satisfaction; it keeps the road in good repair in all seasons.

Western Railway Building

An interesting announcement was recently made in connection with the Dunvegan and Fort McMurray railway now under construction north of Edmonton by the J. D. McArthur Co. 340 miles of railway north of Edmonton are to be ballasted this year. Plans are being prepared for a big steel bridge over Peace River at Peace River Crossing; this will include a traffic deck and the total cost will be about three-quarters of a million dollars. The building of the bridge will enable the line of the Central Canada Railway Company to be continued westward one hundred miles, guaranteed by the provincial government.

Fifty miles already are constructed to Peace River Crossing and the remainder—fifty miles—has been located to the Waterhole district.

By the end of the present winter the total mileage will be as follows:

	Miles.
E.D. & B.C. main line to Spirit River..	357
Grande Prairie branch	60
Central Canada from McLennan to Peace River	50
A. & G. W.	250
Total mileage	717

These roads all were built under the guarantee policy of the provincial government and run through districts that were badly in need of railway facilities.

Mr. McArthur also announced that the Northwest Lumber Company, of which he is president, is cutting 25,000,000 feet of lumber this winter, about 350 men being employed. A cut of 10,000,000 feet is being made near Lac la Biche and another cut of 15,000,000 feet near Sawridge. The mills at West Edmonton will reopen about the middle of March.

Progress on Breakwater, Victoria, B.C.

During 1915 work on the breakwater at Ogden Point, Victoria, B. C., has progressed so rapidly that the structure, which, at the beginning of the year, was not visible above the surface of the water is now two-thirds finished. The breakwater is composed of three arms, the first extending only 330 ft. from shore, the main arm having a total length of 1,500 ft., and the outer arm which will be 700 ft. long. On Jan. 1 the work had been completed for a distance of 1,630 ft. from shore. Over 1,000,000 tons of coarse and fine rubble have been used in the construction thus far, it is reported. J. S. Maclachan, Dominion government engineer, has given out the following figures referring to total quantities thus far handled on this contract: Coarse rubble dumped, 792,415 tons; core, or fine rubble dumped, 241,925 tons; granite blocks placed in position 93,279 tons; concrete poured, 20,883 cu. yd. During 1915 273,000 tons of rubble stone were deposited, 75,000 tons of granite blocks placed and 19,000 cu. yd. of concrete poured.

Mr. Jones Prophesies Good Year

At the annual meeting of the Canada Cement Company, held in Montreal, on February 15, Mr. F. P. Jones, vice-president, stated that an entirely new plant had been erected for the making of munitions, and that the two orders received—one for machining and the other for manufacturing steel and forgings for machining—would keep them fully running until the end of the year. He believed this year's sales of cement would be larger than during 1915. Cities and municipalities could not use less cement during the coming season than they did last year, and were now in a better financial position to carry on improvements. In addition to this all the large Government works, including the Welland Canal, would be continued.

Reinforced Concrete Buildings

In a paper on "Interesting Features of Reinforced Concrete Buildings In and Around Montreal," read at a meeting of the Canadian Society of Civil Engineers, Montreal, Mr. C. M. Morssen, of the Atlas Construction Company, gave a description of cracks in concrete walls, outside finish, winter made concrete, and the adaptability of concrete to complicated structure. As an instance of the latter he referred to St. Michael's Church, corner of St. Urbain and St. Viateur Streets. This building has no columns and is built of plain and reinforced concrete. The basement ceiling is carried by flat arches 54 ft. clear span, having a raise 30 in. The arches are 18 ft. centre to centre and connected with a flat slab 7 in. thick. The main auditorium is covered by a dome, which is carried by four full centre arches, each 52 in. diameter, and by four consoles, which arches and consoles are carried down to rock by four strong tower abutments. The dome is about 118 ft. above the sidewalk and 110 ft. above the auditorium floor.

The outside walls are covered with Greendale brick and terra cotta; the dome and roofs, however, are finished in concrete, the dome having received a colored waterproof cement finish about an inch thick, showing green shamrocks on a white field. The green color was obtained by mixing a green pigment with the ordinary cement and the white color was secured by the Atlas white cement. The main cupola is carried on a series of semi-circular arches fixed rigidly into a heavy ring of concrete reinforced with steel bars in the front of circular hoops. There are 12 semi-circular arches, which are 36 in. deep, 12 in. wide at the bottom and 6 in. wide at the crown. At the crown the arches are connected by a disc 4 in. in diameter and 36 in. deep. Each arch carries 1/12th of the load on the cupola and its own weight.

For the computing of the stresses in the concrete and steel the total weight of the cupola, including suspended ceiling, wind, snow, etc., was taken at 150 pounds per square foot. The twelve semi-circular ribs are reinforced with four one in. twisted bars, two near the top and two near the bottom, and connected with stirrups about every 12 in. The cupola, which is of a uniform thickness of 5 in., is reinforced with 1/2 round bars at 6 in. centre to centre.

Mr. Morssen briefly described the method by which the stresses were ascertained. He stated that the cupola was first designed without ribs and of a uniform thickness of 8 in. following the theory given by E. Collignon, "Cours de Mecaniques," p. 631. This theory is that in a spherical cupola the stress in the material used are independent of the thickness of the cupola and are determined only by the diameter of th cupola and the specific gravity of the material used. With hoops made of 1/2 sq. bars and placed at 9 in. centre to centre the stresses in the steel and concrete would be kept within the safe limits. The thickness of the cupola will be rather governed by the stiffness to be attained than by the safe stresses. However, taking into consideration the large proportions of the cupola it was decided to provide 12 ribs as described, and making the assumption rather more severe than the actual conditions warranted, the stresses in the steel and concrete were kept within the safe limits. As built the cupola is about 40 per cent cheaper than a Gostavino tile cupola and about 50 per cent. cheaper than a steel structure fireproofed with concrete or tiles.

A half spherical cupola at the rear with a diameter of 52 feet, and a small 20 foot cupola at top of the tower are of uniform thickness, and are reinforced with hoops made of round half-bars. The four main arches carrying the cupola, the cantilevers, and the arches in the basement were designed on established methods. The winding stairs and the large windows were made of reinforced concrete, although no established formulae were available.

High Level Reservoir, New Westminster, B. C.

The city of New Westminster, with the completion of the new high level reservoir capable of serving a population of at least 80,000 persons, have realized their ambition of many years' standing to possess an entirely modern waterworks system. The new reservoir was completed in November 1915, construction work having occupied approximately a year. It is situated adjacent to the old reservoir on the highest point within the city limits and, together, they now

Discharge Chamber of Reservoir, at New Westminster.

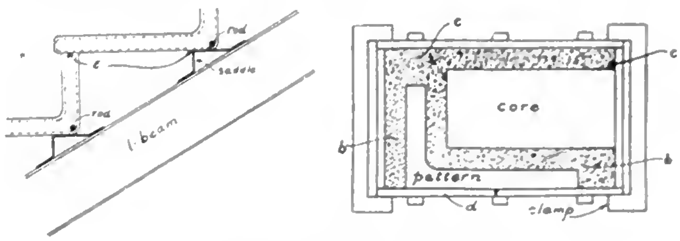
supply the whole area with water. The new reservoir has a capacity of 42,000,000 gallons.

Coincident with the construction of the new reservoir the embankment of the old high level reservoir was raised, adding 500,000 gallons to its capacity. The total capacity of both reservoirs is now 8,900,000—approximately seven days' supply for the present population. The minimum discharge from the 25-in. main is 6,250,000 gallons per 24 hours, with a maximum discharge of 7,000,000 gallons under high-water level on Lake Coquitlam. The 14-in. main has a minimum discharge of 600,000 gallons, with a maximum of about one million. The reservoir was designed by Mr. J. W. B. Blackman, city engineer, at an estimated cost of $40,200, and was built under his supervision with the assistance of superintendent Ankers.

The Commissioners of the Transcontinental Railway have issued their 11th annual report, covering the fiscal year ending March 31, 1915.

Sand Molds for Concrete Steps

In certain classes of work it becomes convenient to use a process of sand casting, for an irregular concrete form which is to be repeated over and over again. The way this is done is in all respects analogous to the casting of iron. The wooden pattern used to prepare the mold in sand is handled in exactly the same way as the pattern for a metal casting. The sketch in Fig. 1 shows how separate sections of the step are placed upon the steel structure which supports them.



Step mold and method of erection.

The molding is a simple matter, the pattern is placed upon the drag (d), Fig. 2 and sand is then rammed all around it (b) within the flask. A hollow wooden core, placed at one side of the flask as shown, makes it unnecessary to use large quantities of sand, and what is more important, largely reduces the weight to be handled. Sand is then rammed up around the top (cc), and the top board put in place and clamped.

The whole thing is then turned upside down with the aid of a small jib crane. Upon removing the drag (d), and the wooden pattern, the form is ready for the insertion of reinforcement in the same way as a mold for an iron casting is completed by the insertion of cores.

Wire cloth with a good-sized mesh is used, as shown in dotted lines in Fig. 1, with a single twisted rod at one corner, as indicated. The cement used is the proportion of 1:2:4, small-sized stone being required because of the small space into which the concrete has to be poured.

The hard packed sand gives a finish to the concrete steps which is final. Nothing more remained to be done in preparing them for erection, with the exception of a little smoothing in some cases at the points (e) at which they come in contact with each other and with the steel structure.

The under side of the step as erected is the surface which is free to the air when cast. Any irregularities appearing in it are hidden by the way in which the steps are erected—Concrete.

A two days' convention of the Canadian Fairbanks-Morse Company, Limited, was recently held in Montreal. The convention was attended by heads of departments, salesmen, and representatives of firms in Canada and the United States whose goods are handled by the Canadian Fairbanks Morse Company. The representatives of these concerns spoke at the convention along the lines of familiarising the heads of departments and salesmen with the various goods. At a banquet held in the St. James Club, Mr H. J. Fuller, the president, referred to the large number of men in the company's service who had volunteered for overseas. Mr. Graham Drinkwater, vice-president; Mr. C. W. Wiggin, manager of the Montreal branch; and Mr. C. J. Brittain, manager of the Winnipeg branch, also spoke.

Stresses in Lattice Bars of Columns

By W. W. Pearse, C.E.

Explanatory

The Editor, Contract Record:—

I send you herewith a discussion on the stresses in lattice bars of columns.

In the Engineering Record of November 2, 1907, I published an article on the same subject, in which I gave a formula for the transverse shear as follows:—

$$R = \frac{232\ A\ r}{n} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where A = area of column,
r = radius of gyration, axis parallel to back of channels,
n = distance from neutral axis to extreme fibre.

Equation (1) was based on the New York law for columns, as follows:

$$\frac{P}{A} = 15{,}200 - 58\frac{l}{r} \quad \ldots\ldots\ldots\ldots (2)$$

Now if the American Railways Engineering Association's formula is used, which is

$$\frac{P}{A} = 16{,}000 - 70\frac{l}{r} \quad \ldots\ldots\ldots\ldots (3)$$

$$\text{Then } R = \frac{280\ A\ r}{n} \quad \ldots\ldots\ldots\ldots (4)$$

This value given in equation (4) is what has been adopted by several authorities.

It will be noticed that the length (l) does not appear in either equations (1) or (4).

Now, referring to equations (2) and (3), if we put $l = 0$, the quantities $58\frac{l}{r}$ and $70\frac{l}{r}$ drop out and there is no stress to be deducted due to the bending of the column

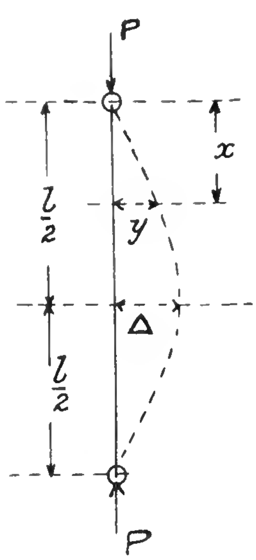


Fig. 1.

or, in other words, as the length of the column approaches zero, the stress to be deducted due to the bending also approaches zero. There is a much greater stress in the column due to bending when the column is long; it is only the stress caused by the bending of the column that causes any stress in the lattice bars.

Referring to Table 1 of the discussion I send you, it will be noted that the stresses for different lengths vary. Columns that are 9 ft. long have much less stress in the lattice bars than columns that are 20 ft long.

It is also evident for the same reasons cited above that the value .0251 given for the transverse shear in Bulletin No.

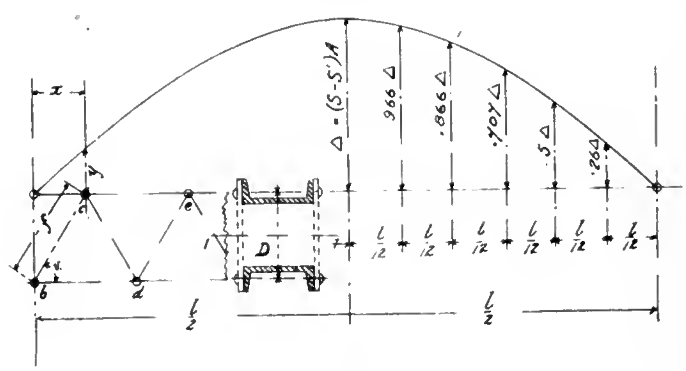


Fig. 2.

44 of the University of Illinois must only be true for values of ratios $\frac{l}{r} = 37.8$ or thereabouts, and you will notice by referring to my Table that for values of 37.8 for $\frac{l}{r}$ my formula agrees very closely indeed with the tests.

For columns that are fixed top and bottom an entirely new discussion and table would have to be worked up along the lines outlined in my discussion.

In conclusion would say that of course there are stresses caused by imperfections in fabrication, etc., that no formula could ever cover.

Yours truly,
W. W. PEARSE,
City Architect and Sup't of Buildings.

Toronto, Feb. 5.

Stresses in Lattice Bars of Columns

The stresses in lattice bars of columns have always been considered, at best, a very rough approximation.

Euler's column theory is universally accepted as a correct analysis of the subject. The following discussion of the stresses in lattice bars is based on the same theory of bending in columns and should be equally as correct.

In Merriman's Mechanics of Materials, 1894 edition, page 115, he gives for Euler's formula, for the resisting of columns, the following equation:—

$$y = \triangle \sin.\ n\,\pi\,\frac{x}{l} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

If it is assumed that the column is hinged top and bottom and a load P is applied, then under these conditions, $n = 1$ and equation (1) reduces to,

$$y = \triangle \sin.\ \pi\,\frac{x}{l} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

See Figure 1.

Let l = length of column in inches.
A = area of column in square inches.
S = safe stress per sq. inch (very short columns).
S' = safe stress per sq. inch (long columns).

Then $(S - S')A$ = total stress due to bending at centre of column.

If equation (2) is plotted assuming l as any length of column in inches, and divided into twelve equal parts, the ordinates shown in Figure 2 will be found and will apply in all cases. If for $\triangle$ we substitute $(S - S')A$, we will get the stress strain curve in the column due to bending of column.

Referring again to Merriman's Mechanics of Materials, 1894 edition, he gives the following column formula:—

$$S^1 = \cfrac{Sc}{1 + \cfrac{Sc}{m \pi^2 E} \times \cfrac{l^2}{r^2}} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

Substituting usual values for the different quantities in equation (3) we get,

$$S^1 = \cfrac{16000}{1 + \cfrac{1}{12000} \times \cfrac{l^2}{r^2}} \quad \ldots\ldots\ldots\ldots\ldots (4)$$

Referring to Figure 2, y = stress* in channel due to bending of column in panel bd. Therefore the stress in lattice bars be is equal to y sec v. There are two lattice bars be so

$$\text{stress in each bar be} = \frac{y \sec v}{2} \quad \ldots\ldots\ldots\ldots (5)$$

But the angle v is usually taken at 60 degs. and the secant of 60 degs. is 2,

Therefore the stress in the lattice bar be = y .... (6)

As the stress in the lattice bar be is a maximum, all that it is necessary to do is to design one lattice bar for the end panel and make the balance of the bars the same length and area. Each end lattice bar would have to be designed to act as a column having a length equal to f and a load equal to y.

Referring to Bulletin No. 44, University of Illinois, page 47, they give a formula for lattice bars as columns based on actual tests:—

$$\frac{P}{A} = 21400 - 45 \frac{l}{r} \quad \ldots\ldots\ldots\ldots\ldots (7)$$

Equation (7) gives the ultimate fibre stress per square inch.

*It should be noted here that this whole stress is taken up by one channel when the axis of bending is parallel to back of channels, for when the column bends one channel will be plus and one channel will be minus, and it is only the plus side that adds any additional stress to the column, and it is this stress that must be deducted from the carrying capacity of the column due to bending.

Length of Col. in feet.	Size of Channels.	D = Distance C.C. of rivets perpendicular to the flange.	A = Area of Col. in sq. inches.	r axis 1-1,	l/r	S' = Safe load per. sq. inch	(S - S') = Stress per sq. inch to be deducted due to bending	x	f = 2x for an angle of 60°	y = Stress in end Lattice Bars, in lbs.	Stress in end Lattice Bars according to tests in lbs.	Section of Lattice Bars required.
9'-0"	2-6" @ 8#	5¾"	4.76	2.34	46	13600	2400	3.32"	6.6"	1100		2¼" × 5/16"
"	2-7" @ 9¾#	6¾"	5.7	2.72	40	14200	1800	3.9"	7.8"	1160	1170	"
"	2-8" @ 11¼#	7½"	6.7	3.11.	34	14600	1400	4.33"	8.66"	1180		"
"	2-9" @ 13¼#	8¼"	7.78	3.45.	31.	14800	1200	4.76"	9.5"	1290		"
"	2-10" @ 15#	9¼"	8.92	3.81	29	14950	1050	5.34"	10.7"	1450		"
"	2-12" @ 20½#	11¼"	12.06	4.61.	23	15350	650	6.5"	13.0"	1484		2¼" × 3/8"
"	2-15" @ 33#	13¼"	19.8	5.6	19	15550	450	7.65"	15.3"	1870		2½" × 7/16"
12'-0"	2-6" @ 8#	5¾"	4.76	2.34	61	12200	3800	3.32"	6.6"	1300		2¼" × 5/16"
"	2-7" @ 9¾#	6¾"	5.7	2.72	53	12950	3050	3.9"	7.8"	1360		"
"	2-8" @ 11¼#	7½"	6.7	3.11	46	13650	2350	4.33"	8.66"	1420		"
"	2-9" @ 13¼#	8¼"	7.78	3.45	42	14000	2000	4.76"	9.5"	1600		"
"	2-10" @ 15#	9¼"	8.92	3.81	38	14300	1700	5.34"	10.7"	1760	1825	"
"	2-12" @ 20½#	11¼"	12.06	4.61	31	14800	1200	6.5"	13.0"	2030		2½" × 3/8"
"	2-15" @ 33#	13¼"	19.8	5.6	25	15200	800	7.65"	15.3"	2600		2½" × 7/16"
15'-0"	2-6" @ 8#	5¾"	4.76	2.34	77	10700	5300	3.32"	6.6"	1450		2¼" × 5/16"
"	2-7" @ 9¾#	6¾"	5.7	2.72.	66	11700	4300	3.9"	7.8"	1670		"
"	2-8" @ 11¼#	7½"	6.7.	3.11	58	12500	3500	4.33"	8.66	1770		"
"	2-9" @ 13¼#	8¼"	7.78	3.45	53	13000	3000	4.76"	9.5"	1930		"
"	2-10" @ 15#	9¼"	8.92	3.81	46	13650	2350	5.34"	10.7"	1940		"
"	2-12" @ 20½#	11¼"	12.06	4.61	39	14200	1880	6.5"	13.0"	2560	2440.	2½" × 3/8"
"	2-15" @ 33#	13¼"	19.8.	5.6	32	14700	1300	7.65"	15.3"	3400		2½" × ½"
18'-0"	2-6" @ 8#	5¾"	4.76	2.34	92	9350	6650	3.32"	6.6"	1510		2¼" × 5/16"
"	2-7" @ 9¾#	6¾"	5.7.	2.72	80	10700	5300	3.9"	7.8"	1700		"
"	2-8" @ 11¼#	7½"	6.7.	3.11	70	11380	4620	4.33"	8.66"	1940		"
"	2-9" @ 13¼#	8¼"	7.78	3.45	63	12000	4000	4.76"	9.5"	2120		"
"	2-10" @ 15#	9¼"	8.92.	3.81	57	12600	3400	5.34"	10.7"	2340		"
"	2-12" @ 20½#	11¼"	12.06	4.61	45	13650	2350	6.5"	13.0"	2680		2½" × 3/8"
"	2-15" @ 33#	13¼"	19.8	5.6	39	14200	1750	7.65"	15.3"	3937	4040	2½" × ½"
20'-0"	2-10" @ 15#	9¼"	8.92	3.81	63	11400	4600	5.34"	10.7"	2860		2½" × 3/8"
"	2-12" @ 20½#	11¼"	12.06	4.61	53	12950	3050	6.5"	13.0"	3120		2½" × 3/8"
"	2-15" @ 33#	13¼"	19.8	5.6	42.8	13900	2100	7.65"	15.3"	4060	3940	2½" × ½"

Table 1

Therefore the safe load would be:—

$$\frac{P}{A} = 6600 - 45\frac{l}{r} \quad \ldots\ldots\ldots\ldots\ldots \quad (8)$$

Equation (8) is using a factor of safety of 3¼, which is about the same as is given in equation (4).

Referring now to Figure 2, it will be noticed that the y ordinate for the end panel, right hand side, is .26 △ or very nearly half that found for the second panel, which is .5 △, this shows that the curve is very nearly a straight line at each end. Assuming that it is a straight line, the following analysis may be made:—

Referring to Fig. 3 we get the following:—

$$\text{Tan } z = \frac{.26\,\triangle}{\frac{l}{12}} = \frac{3.12\,\triangle}{l} \quad \ldots\ldots\ldots\ldots\ldots \quad (9)$$

Therefore $y = x \tan z$.

$$\text{or } y = \frac{3.12\,\triangle\,x}{l} \quad \ldots\ldots\ldots\ldots\ldots \quad (10)$$

If for △ we substitute $(S - S^1)$ A, equation (10) becomes

$$y = \frac{3.12\,(S - S^1)\,A\,x}{l} \quad \ldots\ldots\ldots\ldots\ldots \quad (11)$$

Equation (11) will give the stress in end lattice bar be,

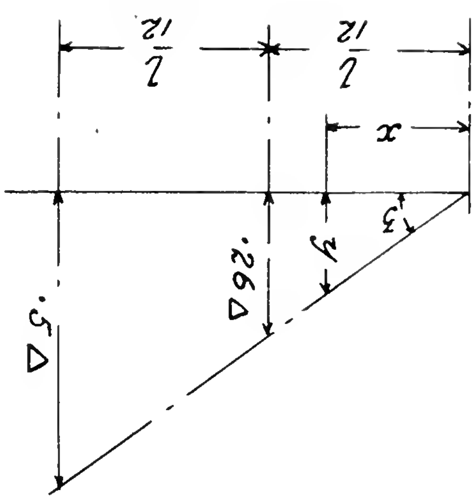


Fig. 3.

which will always be a maximum. Value for S^1 must be found by equation (4) or any other column formula that may be desired to find the safe load per square inch of column.

From equation (11) Table No. 1. was figured, which gives the stress in the end lattice bars for channel columns having lengths of 9 ft., 12 ft., 15 ft., 18 ft., and 20 ft. For intermediate lengths it would be safe to interpolate. For different areas it will be directly proportional to the area, as will be seen by referring to equation (11).

In figuring Table I. the values D, A, r, and x were taken from Cambria Steel Company's Handbook, see Fig. 2.

If the angle v is not 60 degs. then equation (11) will become,

$$y = \frac{3.12\ (S - S^1)\ Ax}{l} \cdot \frac{\text{sec. } v}{2} \quad \ldots\ldots\ldots\ldots\ldots \quad (12)$$

which reduces to,

$$y = \frac{1.56\ (S - S^1)\ Ax}{l}\ \text{sec. } v. \quad \ldots\ldots\ldots\ldots\ldots \quad (13)$$

Note:—Equations (11) and (13) are only true for the end panel.

Now to prove that equation (11) and (13) are correct and agree with experiments, refer to Bulletin No. 44, of the University of Illinois, page 33, supplementary to Table 6, where it gives in the last column of the table,—ratio of transverse shear to compression load = .0251. This was the result of tests on column marked 1. By referring to page 10 of the Bulletin 44 a full description is given of Column No. 1:—A = 18.76; L = 21 ft.; $\frac{l}{r} = 37.8$; angle of lattice bar with axis of column = 63 degs. 30 mins.

It seems reasonable that all columns having a ratio of $\frac{l}{r} = 37.8$ or thereabouts and having the lattice bars sloping approximately 63 degs. 30 mins. should have a ratio of transverse shear to compression load = .0251. Referring to Table No. 1 herewith it will be noticed that for two 15-in. channels at 33 lbs., 20 ft. long, the stress given in the end lattice bar is 4060 lbs. $\frac{l}{r} = 42$, which is reasonably close to what is given in the tests to give approximately the same results. Therefore we get for transverse shear the following, where A = 19.8 and the compressive load per sq. inch = 13900 lbs.:

Transverse shear = 19.8 × 13900 × .0251 = 6880 lbs.

But there are two lattice bars,

Therefore $\frac{6880}{2}$ = 3440 lbs. transverse shear on each lattice bar, see Fig. 4.

The secant of 30 degs. = 1.155. Therefore 3440 × 1.155 = 3973 lbs. = stress in end lattice bar, which is very nearly what is given in Table 1, which is 4060 lbs.

Referring to Table 1 again, it will be noticed that for two 7-in. channels at 9¾ lbs., 9 ft. long; $\frac{l}{r} = 40$, $S^1 = 14200$ lbs. and stress in end lattice bar is 1160 lbs. And A = 5.7 square inches.

Therefore, transverse shear = 5.7 × 14200 × .0251 = 2030 lbs., and $\frac{2030}{2}$ = 1015 lbs. = transverse shear for each lattice bar.

Then 1015 × 1.155 = 1170 lbs., which is within 10 lbs. of that given in the formula, which was 1160 lbs.

Referring to Table 1., two 10-in. channels at 15 lbs., 12 ft. long, $\frac{l}{r} = 38$, $S^1 = 14300$ lbs. per sq. inch, A = 8.92 sq. inches, stress in the lattice bar = 1760 lbs.

Transverse shear = 8.92 × 14300 × .0251 = 3200 lbs.

Therefore $\frac{3200}{2}$ = 1600 lbs. transverse shear for each lattice bar. Then 1600 × 1.155 = 1848 lbs. stress in lattice bar, which is within 88 lbs. of what is given in Table 1.

Referring to Table 1, two 12-in. channels at 20½ lbs., 15 ft. long, $\frac{l}{r} = 39$, $S^1 = 14200$, stress in lattice bar = 2560

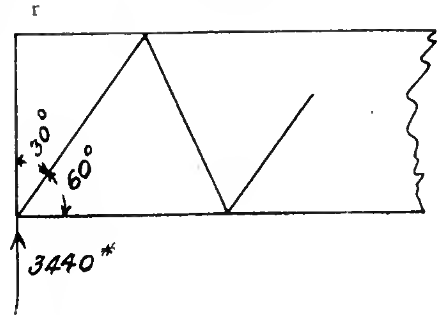


Fig. 4.

lbs., A = 12.06 sq. inches, transverse shear = 12.06 × 14200 × .0251 = 4300 lbs.

Therefore, $\frac{4300}{2}$ = 2150 lbs. transverse shear for each lattice bar. Then 2150 × 1.155 = 2480 lbs. stress in lattice bars, which is 80 lbs. less than Table 1 gives.

Referring to Table 1, two 15-in. channels at 33 lbs., 18 ft. long, $\frac{l}{r} = 39$, $S^1 = 14200$, stress in lattice bar = 3937 lbs., A = 19.8 sq. inches, transverse shear = 19.8 × 14200 × .0251 = 7060 lbs.

Therefore, $\frac{7060}{2}$ = 3530 lbs. transverse shear for each lattice bar. Then 3530 × 1.155 = 4077 lbs. stress in lattice bar, which is 80 lbs. less than Table 1 gives.

Sizes of lattice bars given in the last column of Table 1 were figured by equation (8).

The Practical Value of Curves

The Application of Curves, Charts and Graphs to Facilitate the Analysis of Engineering Problems and Statistical Information

By F. H. Martin*

The talk this evening can hardly be termed a paper—it is more in the nature of a resume or collection of curves and diagrams that have been found helpful, especially in preliminary design work, and they are described in the hope that they may be of value to some of you.

It was the intention originally to analyse the mathematical side of the art of curve plotting, but mathematical discussions are usually rather dry, so this phase has been omitted and may be taken up later in the season if desired.

The talk this evening will be confined to the practical values of the curves which will be shown after a few introductory remarks:

Graphs are statements of results presented by means of diagrams, geometrical figures, or pictures to delineate or convey information in a vivid, forcible, and instructive manner; to put it tersely, it might be termed a picturization of facts.

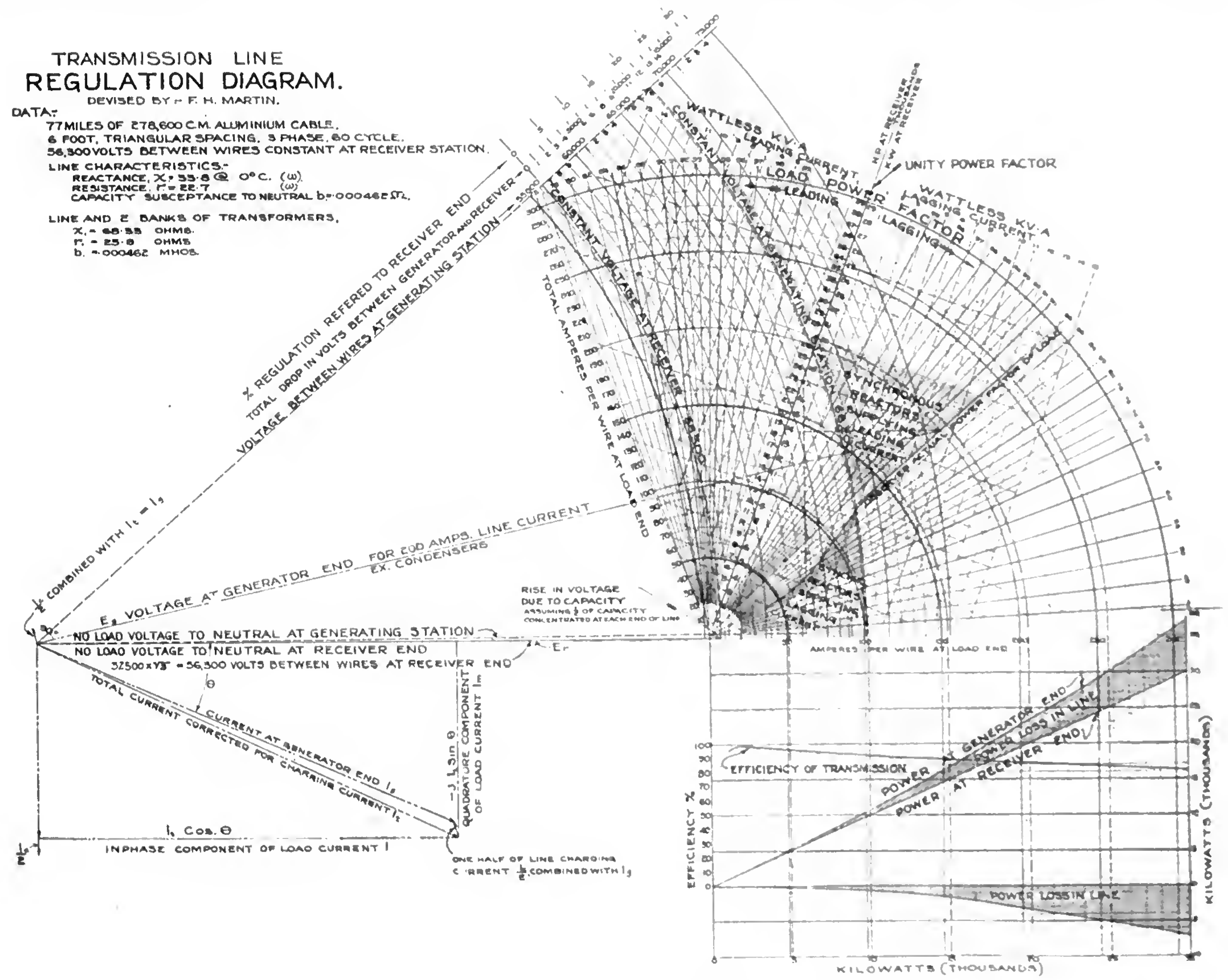
Charts are maps of results or facts, similar to, but slightly more complex, than graphs.

By reducing the value of facts to properly proportioned pictures or symbolic drawings, and arranging these geometrical diagrams in such a position that their relationship is apparent, their relative values, are instinctively appraised by the eye, and the lesson they are intended to teach, promptly and easily grasped.

Statistics are a collection of facts tabulated numerically, or, a group of facts brought out by collecting numbers; in other words, it is the science of measurements of the social organism.

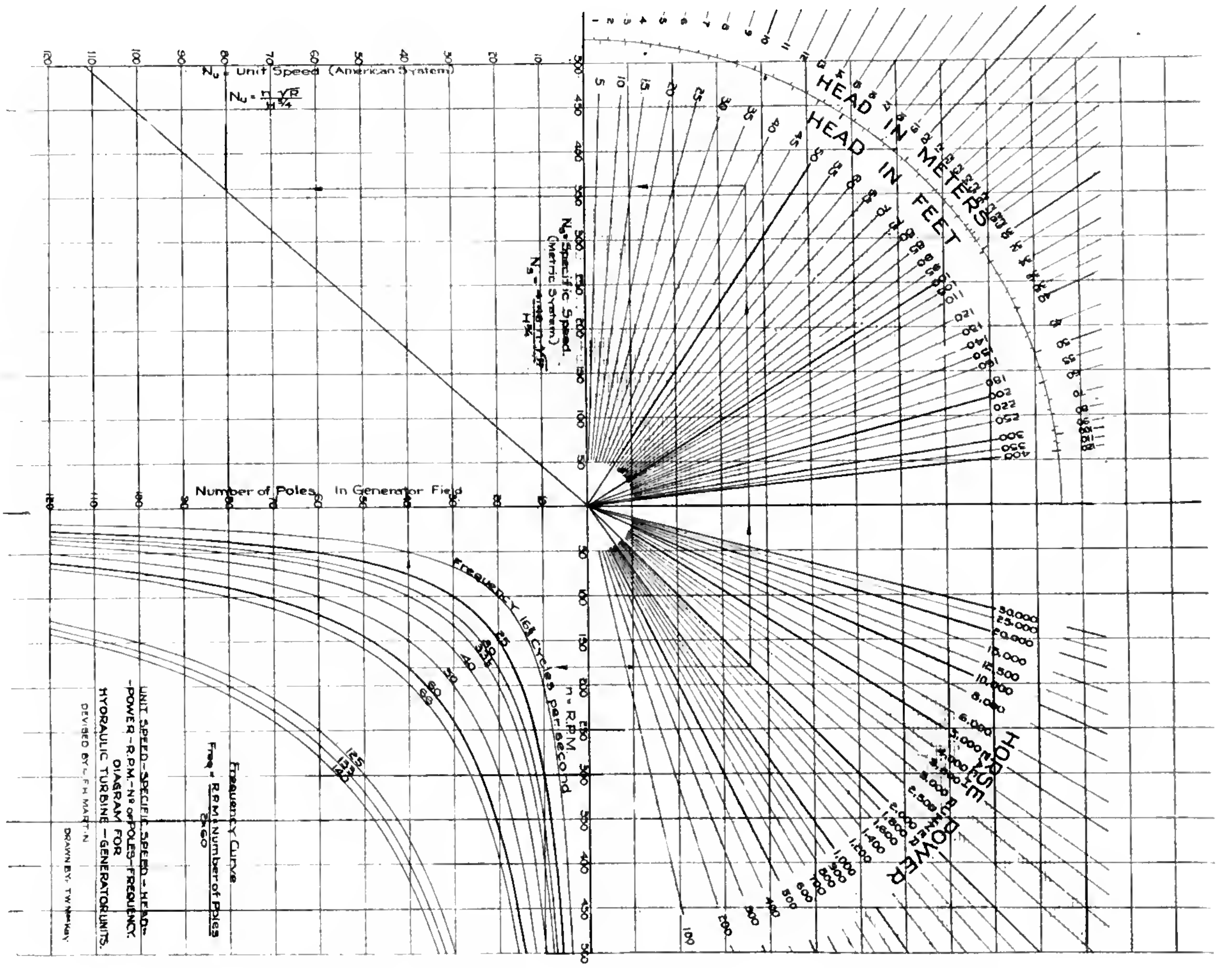
Each year thousands of dollars are spent in collecting all kinds of data, which is usually arranged in a tabulated form, and anyone who has ever had an occasion to analyze this enormous mass of information will have felt the need of a more coherent and concise means of arranging the same, in order to enable the average individual to recognize the salient features of these facts, and, to serve as a guide in making correct deductions therefrom, instead of accepting ready made conclusions handed to him.

If the average citizen, and, especially the business man who usually dodges the simplest charts, obsessed with the



Transmission line regulation diagram.

*Designing Engineer, Winnipeg River Power Company, before the Electrical Section of the Manitoba Branch of the Canadian Society of Civil Engineers.



Unit speed—Specific speed—Head—Power—R.P.M.—No. of poles—Frequency diagram for hydraulic turbine—Generator units.

idea that they involve higher mathematics, or, some other mysterious agency, knew how to interpret charts and curves, it would be feasible to elucidate to him in effective form those facts, relating to broad social and public improvements, public-service operations, and international, state or municipal affairs.

To the ordinary person this does not seem to be a matter of great importance, and at first sight we cannot see its relationship to engineering, but when we consider that during the five years that the French engineers labored on the Panama Canal, they lost 22,189 men, while America has lost 5,000 in twice that time, and has also succeeded in transforming the region from one of the most deadly to one of the most healthy localities on this continent, due largely to the praiseworthy efforts of Surgeon-General Gorgas, who recognized how potent in the reductions of the cause of those losses are sanitary environments and the separation of the infected from the sound, we see how essential it is to standardize all the facts that would influence an engineering project in such a manner as to permit just comparison being made and then analyze the results graphically so that correct deductions can be made. Then there will no longer be any excuse for acting in ignorance since the curves will show exactly what is happening so that all conscientious workers for social, sanitary and other reforms will be able to discover at once the direction in which it is most desirable to concentrate attention.

The two principal methods of elementary statistics which ought to be understood by all students or officials who handle figures, and, which are easily within the grasp of all independent of mathematical training, but which are generally misunderstood, or ignored by the uninterested or uninitiated, are, the method of averages, and the method of diagrams, or the graphic method.

When we deal with large and complex masses of figures, we are unable to grasp them in their entirety, however clearly they may be tabulated. A list of figures, as for instance, the population of different cities, the wages of numerous individuals, etc., becomes less comprehensive as its length increases. A list of ten numbers can easily be grasped, of twenty, only with an effort, even by the highly skilled reader, while a series of figures for one hundred successive years leaves hardly any impression on the mind at all—we cannot see the wood for the trees—and we find that this also holds true in all fields of endeavor.

As civilization advances there is being brought to the attention of the average individual a constantly increasing volume of comparative figures and general data of a scientific, technical, and statistical nature. The graphical method permits the presentation of such figures and data with a great saving of time, and also with more clearness than would otherwise be obtained.

If simple and convenient standards can be found and made generally known, and adhered to, there will be possible a more universal use of graphic methods, with a consequent gain to mankind, because of the greater speed and accuracy with which complex information may be imparted and interpreted.

The graphic method is also used in solving problems in every branch of engineering (which otherwise would involve very complicated or laborious mathematical computation) by drawing vectors to scale, and estimating slopes and arears under curves. This method not only gives the student a mental picture of the operation, but compels him to think of the relation between the various quantities involved, instead of merely performing operation by fixed rules, and the principles so illustrated are more deeply impressed.

Much of the work of calculation done by engineers or designers is in the repeated application of a limited number of formulas to a variety of different conditions, which involves merely the substitution of different variables in identical equations. Any mechanical means for performing this operation expeditiously will not only lead to a saving of time and mental wear and tear, but will also minimize the chances of error. Such a device is the calculating chart, or monogram, and the increasing frequency with which it is employed in the more recent publications, is a good evidence of the growing recognition of its value.

Many excellent examples of these charts have appeared of late years and are available for use, but it is evident that, to realize their full value as useful instruments, the engineer should have a sufficient acquaintance with their underlying principles to construct charts suited to his individual needs.

Some of the chart forms employed to-day have been known and used for many years, but it is only within recent times that any systematic study has been made of the subject as a whole, or any attempt to properly classify and correlate the different types.

In this work the French have been pioneers, and, it is to one of them, Maurice D'Ocagne, that we owe what is probably the most thorough and comprehensive text on the subject, his "traite de Nomographie." Soreau and others have also produced very creditable work on this subject.

Although books on Nomography have been published in many foreign languages, there does not appear to have been anything written on the subject in English, outside of a few scattered magazine articles, which have covered only restricted portions of the field.

Books in English on graphical calculus are by no means uncommon, but this is generally looked upon as something different from Nomography, although a strict line of demarcation between the two subjects would be somewhat difficult to trace.

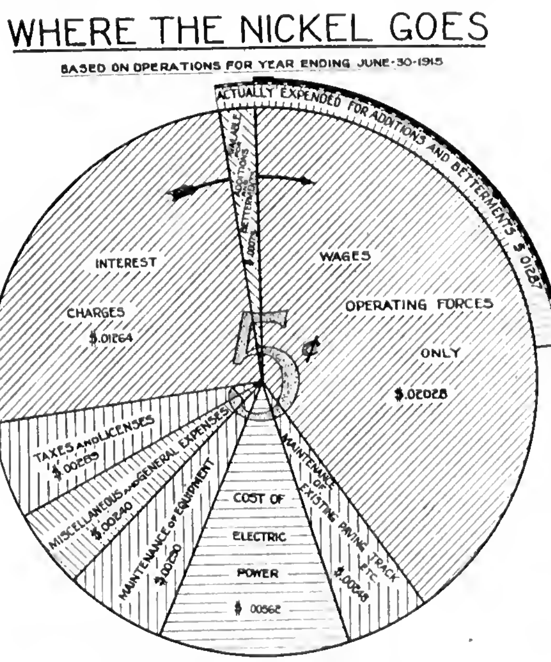


Diagram showing distribution of revenue.

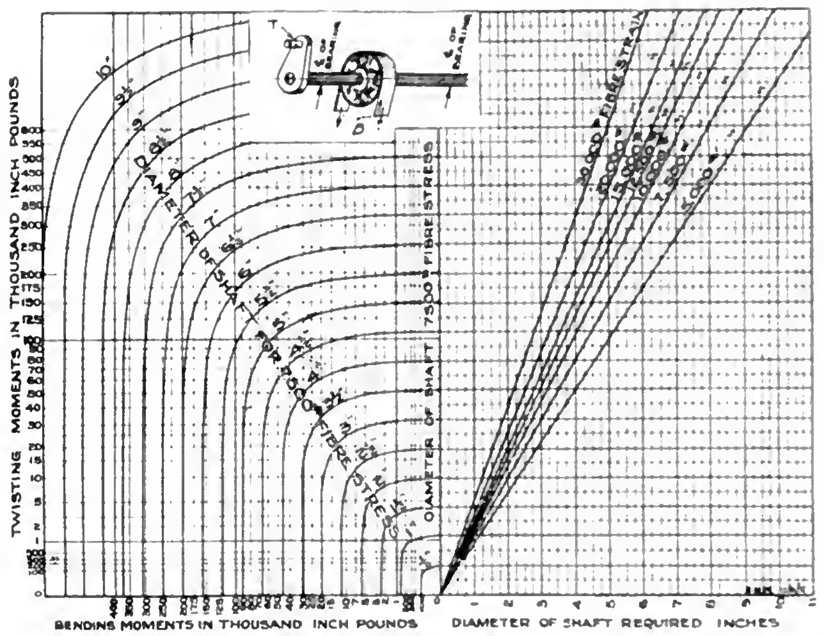


DIAGRAM OF STRENGTH OF ROUND SHAFTS, COMBINED TWISTING AND BENDING MOMENTS

Believing that this subject should be particularly useful to the practical engineer, who is often a trifle rusty in some parts of his mathematics, an effort has been made to simplify the mathematical treatment, and a series of problems has been worked out in detail, illustrating the application of all the chart forms herein explained.

It is thought that a study of these would afford a clearer insight into the methods employed, and a better understanding of the difficulties likely to be encountered, than would be possible from a purely theoretical analysis.

It will be observed that the corresponding metric dimensions have been added to the scales of some of the diagrams shown, this practically makes the charts international in character and like music, they may be arranged and interpreted in any language. This feature is greatly appreciated by engineering organizations whose scope is international and frequently saves considerable time in translating and converting from one system to the other.

The great advantage of the graphic method is that all of mankind's observations and calculations may be arranged or charted on co-ordinate paper, just as the hydrographer charts the position of the coasts, islands, rocks, channels, etc., on a chart, which is used to guide the mariner on his voyage, so the graphic method may be employed as a guide, especially for preliminary designs and estimates.

The prevailing tendency in engineering design is towards projects of greater magnitude containing a minimum number of units of maximum output, in making the initial layouts the approximate dimensions of the various apparatus must often be guessed at, and the uncertainty as to the exact requirements to be fulfilled by the work when completed is also a disadvantage, which cannot be escaped; but the more difficult it is to reach absolute correctness, the greater need we have of some guide which shall reduce the unavoidable guess-work to its lowest terms, and to save us from manifold hazards which result from not only guessing at facts, but at the effects of those facts.

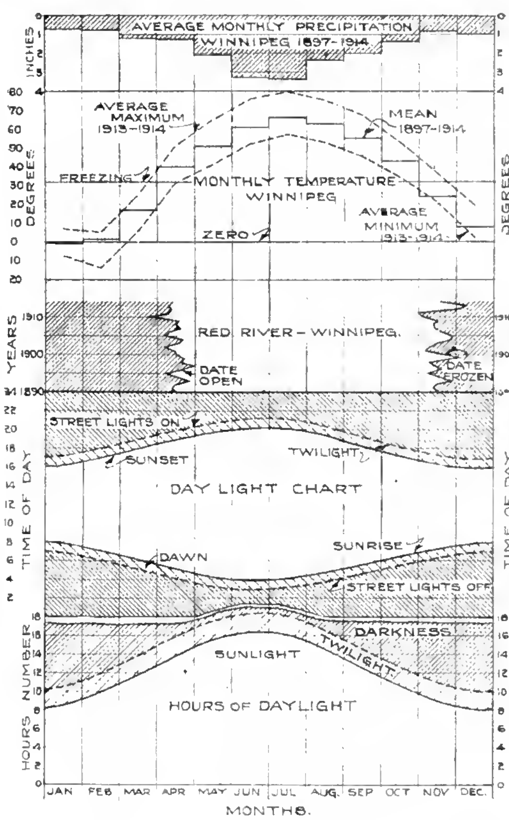
Whatever care we use we can never attempt with success to fix the exact point where economy ends and extravagance begins, but the graphic method helps us to establish certain narrow limits in either direction, somewhere within which lies the truth, and anywhere outside of which lies a certainty of error.

The final results must, of course, always be modified according to the results desired, conditions of working, the personal elements, etc., and accurate computations made for each particular case. The whole value of the charts shown this evening lies in their suggestive possibilities, as no attempt has been made to apply them to any specific case.

The continuation of this article, which will appear in a subsequent issue, covers the mathematical phase, starting from the simple geometric definition of a point in space moving in the shortest direction between two points generating a line, or one dimensional unit, movement of the line generating a plane or two dimensional unit, motion of the plane in a direction not contained within itself, generating a cube of three dimensions, and so on.

There will be explained more fully the two dimensional planes, containing the X and Y axis, which divides the plane into four quadrants, also positive and negative numbers, rectangular and polar co-ordinates, complex quantities involving the quadratic or square root of minus one quantities, which are so helpful in solving alternating current computations, and the equations for the straight line, circle, parabola, hyperbola and higher curves; graphical calculus; including integration and differentiation.

The graphical analysis of all of these gives a much clearer insight into their value, and allows the average individual to apply them daily to the solution of what would otherwise appear very complex problems. Until recent years



Daylight-temperature-precipitation chart for Winnipeg.

it was regarded as a very advanced and difficult branch of pure mathematics, its knowledge being the possession of a privileged few and especially endowed mathematicians.

The study of graphics is a common one, and no branch of mathematics knowledge has a more practical application. This is as it should be, for the fundamental ideas of graphics are common possessions.

New Books.

Kidder's Architects' and Builders' Pocket Book—a handbook for architects, structural engineers, builders, and draughtsmen, by the late Frank E. Kidder, C. E., Ph.D., Thomas Nolan, Editor-in-Chief; sixteenth edition; John Wiley & Sons, Inc., New York, publishers; price $5 net.

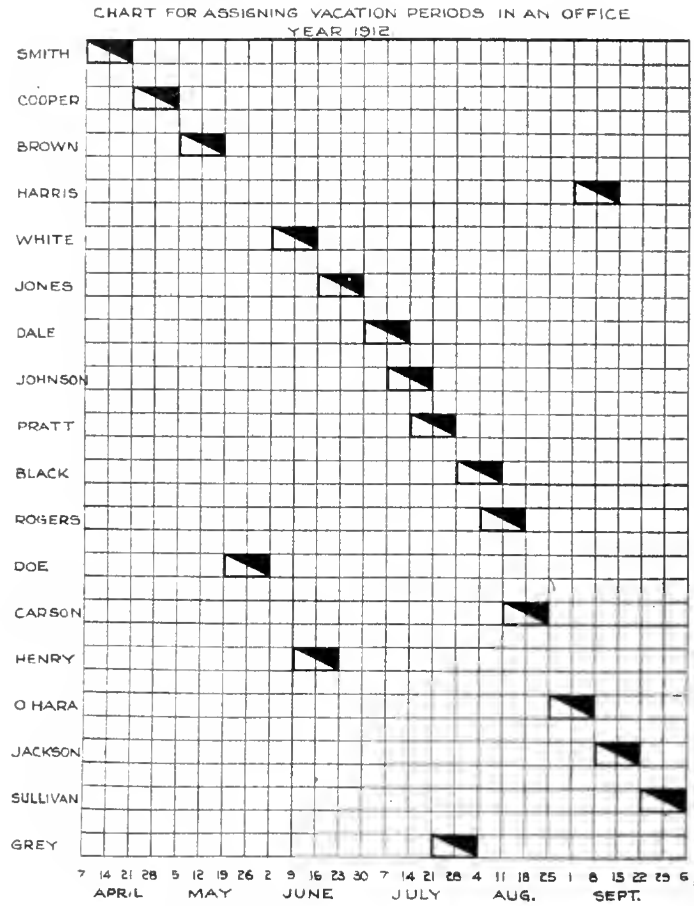


Chart for assigning vacation periods in an office.

The present edition is the result of an entire re-writing and resetting of the earlier editions. This book should prove particularly valuable as a reference, as its very broad scope may be gathered from the following brief review of the contents. Part I. deals with practical arithmetic, geometry, and trigonometry. Part II. deals with the strength of materials and the stability of structures, under the following chapter headings: (1) Explanation of terms used in architectural engineering; (2) Foundations; (3) Masonry walls, footings for light buildings, cements, and concretes; (4) Retaining-walls, and vault-walls; (5) Strength of brick, stone, mass-concrete, and masonry; (6) Forces and moments; (7) Stability of piers and buttresses; (8) The stability of masonry arches; (9) Reactions and bending moments for beams; (10) Properties of structural shapes, moment of inertia, moment of resistance, section-modulus, and radius of gyration; (11) Resistance to tension, properties of iron and steel; (12) Resistance to shear, riveted joints, pins and bolts; (13) Bearing-plates and bases for columns, beams and girders. Brackets on cast-iron columns; (14) Strength of columns, posts and struts; (15) Strength of beams and beam girders. Framing and connecting steel beams; (16) Strength of cast-iron lintels and wooden beams; (17) Strength of built-up, flitched and trussed wooden girders; (18) Stiffness of continuous girders; (20 Riveted steel plate and box girders; (21) Strength and stiffness of wooden floors; (22) Wooden mill and warehouse construction; (23) Fireproofing of buildings; (24) Reinforced-concrete construction; (25) Reinforced-concrete factory and mill construction; (26) Types of roof-trusses; (27) Stresses in roof-trusses; (28) Design and construction of roof-trusses; (29) Wind-bracing for tall buildings. Part II. contains useful information for architects, builders, and superintendents, under the following chapter headings: (1) Heating and ventilation, heat, fuel, gas and gas-piping; (3) Lighting and illumination of buildings; (4) Electric work for buildings; (5) Architectural acoustics; (6) Miscellaneous data. 1816 pages; flexible covers; well illustrated; 4½ by 7 ins.

Haddin & Miles, Limited

It is announced that the name of the John Galt Engineering Company, Limited, has been changed to Haddin & Miles, Limited. The company have offices in Winnipeg and Calgary, the Winnipeg address being the Curry Building. They will specialize in the design and construction of waterworks, sewerage, sewage purification works, electric lighting and general municipal engineering. Mr. John Haddin, M. Can. Soc. C. E., A. M. I. C. E., well known throughout the Dominion in connection with his work in the John Galt Engineering Company, Limited, is the chief member of the firm.

Sub-contractors on Rogers Pass Tunnel Win Suit for Bonus

Damages for breach of contract in connection with construction work on the Canadian Pacific Railway tunnel at Rogers Pass were recently awarded McIlwee & Sons, of Denver, Col., in their claim against Foley Bros., Welch & Stewart, of Vancouver, B. C., by a judgment of the Privy Council, delivered in London, England. The exact amount of damages has not yet been decided, but it is reported that the council upheld the principle that McIlwee & Sons were entitled to full damages, including profits, just as if they had been allowed to complete the contract.

After Foley Bros., Welch & Stewart secured the contract for boring the five-mile tunnel at Rogers Pass, they sublet the contract for the pioneer and center headings to McIlwee & Sons, offering as a special inducement for rapid work a bonus of $1,000 a foot for every foot over a stipulated advance to be made each month. McIlwee & Sons began work and made such rapid progress that at the end of three months they had a claim for bonus amounting to over $200,000. Difficulties then arose between the engineers on the work and McIlwee & Sons were ordered to stop work and vacate the contract for alleged refusal to obey the orders of Foley Brothers' engineers. After a period of six weeks permission was given to McIlwee & Sons to resume work, but instead they quit work entirely and brought suit for $500,000 for breach of contract. The amount was later increased to $800,000.

Bill to Include Outside Contractors Rejected

The Bill of the Montreal Council amending the by-laws contained a clause imposing a tax of $50 on contractors from outside municipalities doing work in Montreal. When the Bill came before the Private Bills Committee on February 11 it was very strongly opposed and was rejected. Alderman Turcot spoke in favor of the tax, pointing out that contractors from outlying districts could come into Montreal and get contracts while Montreal contractors had to pay a tax before seeking business in outside municipalities, and several complaints had been received of unfair treatment of Montreal contractors. The Hon. Walter Mitchell objected to the clause on the ground that it might deprive citizens of the advantages of competition and thus result in higher prices.

Is It Any Wonder It Sets?

Here is a new definition of that prosaic material, Portland cement, by Mr. Jerome Cochran, an American author of technical repute:—"Portland cement shall be defined as the finely pulverised product resulting from the calcination to incipient fusion, of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition of other material greater than 3 per cent. has been made subsequently to calcination. No slag, pozzolana, sand, nor mixed cements will be accepted under this classification. In other words, the cement shall be manufactured of a mixture of argillaceous and calcareous material in definite proportions, and shall contain no furnace slag, grey limestone, hydraulic lime or trass."

Personals

Mr. P. A. Macdonald, the recent appointee as Manitoba Public Utilities Commissioner, who succeeds Mr. H. A. Robson, K.C., was born in Gananoque, Ont., in 1857, and educated at Queen's University, graduating in 1876. Following his graduation he studied law in Toronto and began practising in Winnipeg in 1880. In 1888 he was appointed Master and Referee in the Court of King's Bench, which position he held until 1911, when he resigned to open an office for private practice. The new Commissioner thus brings to his work qualifications and experience which eminently fit him for the position. His many years of service as Referee and Master in the Court of King's Bench brought him in touch with law and business of various kinds. His appointment

Commissioner Macdonald.

on numerous boards of arbitration—notably the labor dispute between the C. P. R. Company and its employees in 1908, of which board Mr. Macdonald was chairman—also shows a widely-recognized public appreciation of his sound judgment.

Commissioner Macdonald will be assisted in his work by an engineering staff, who will not only be at the service of the Commission in aiding investigations and settling technical disputes, but will also be available for the purpose of conferring with and advising upon the operation of telephone, gas, electric, and water supply systems, whether private or municipal, in any matters arising in the course of business. By the aid of these engineers the Commissioner will be relieved of the hearing of conferences between persons interested in purely technical matters, and will thus be relieved of certain burdens of office and left freer to devote his time to larger administrative work.

Mr. Seton Goes to Ottawa

Mr. Bertram W. Seton, a member of the Dominion Engineering and Inspection Company, has temporarily severed his active connection with that company to take charge of the Adjustment Department of the Imperial Munitions Board for such time as the Board will require his services. He commenced his duties on February 21, his headquarters being in Ottawa. Mr. Seton was born in Australia and obtained his early mechanical engineering experience at the Sydney Technical College in New South Wales. He also gained considerable practical experience in mechanical engineering shops in the same city. Later he spent some time at sea in the capacity of engineer on steamships plying between Australian ports, Japan and England. Following his sea experience he held an engineering position with William Beardmore & Sons' Naval Construction Works in Glasgow, Scotland, and afterwards was inspecting engineer with E. G. Carey, consulting engineer, Glasgow. Mr. Seton came to Canada in 1911 and organized the Dominion Engineering and Inspection Company jointly with Mr. H. J. Griswold, of Montreal, and for some time has had charge of the Toronto end of this firm's business. The position to which Mr. Seton has been appointed is a responsible one, and his wide technical and mechanical experience will prove invaluable in adjusting and overcoming any difficulties which may be met with in the manufacture of munitions.

Mr. Bertram W. Seton.

Obituary and Mainly Constructional

Precision Tool and Machinery Company, Limited, Montreal, have registered.

Gilletz & Company, builders and contractors, Montreal, Que., have registered.

Mr. Alphonse Venne, architect, has been re-elected Mayor of St. Lambert, P.Q.

The Kingfisher Mining and Development Company, Winnipeg, Limited, have been incorporated.

The Canadian Highway Engineering and Contracting Company, Montreal, Que., have registered.

Building permits to the value of $12,810 were issued in Toronto during the first eight days of February.

The contracting firm of James Worswich & Company, Limited, Winnipeg, Man., have increased their capital to $200,000.

Building operations in Quebec City are beginning to take an upward trend. During the week ending February 12 ten permits, of a value of $18,400, were issued.

The management and employees of the Canada Metal Company, Toronto, on February 12 laid the foundation of what will be one of the largest shot factories in Canada.

The death of Mr. F. W. Spencer architect, of Sydney, N. S., occurred on the 9th inst. Mr. Spencer, who was 47 years of age, had been engaged in his profession in Sydney for a number of years, and had designed a number of the larger buildings in that city.

Mr. Alexander C. Humphreys, president of the Stevens Institute of Technology at Hoboken, N. J., and one of the leading engineers of the United States, was the speaker at the Canadian Club luncheon held in the Chateau Laurier, Ottawa, on the 10th inst.

Mr. Walter R. Leavens passed away at his home in Hallowell Township, Ont., recently, at the age of 59. He had been road surveyor for the township of Hallowell for many years, and had superintended the construction of most of the bridges in that district.

Mr. H. S. Van Scoyoc, chief engineer, Toronto-Hamilton Highway, read a paper on Wednesday, February 16, before the American Concrete Institute at their Chicago Convention. The subject of Mr. Van Scoyoc's paper was, "Construction of the Toronto-Hamilton Highway by Day Labor."

The Board of Control of the city of Toronto have recommended the expenditure of $60,000 on equipping the new Registry Office building with steel filing apparatus and other metal furniture, as well as the provision of electric lighting fixtures. This equipment was not included in the building specification.

Mr. Henry Brown, manager of the South Stukely Marble Quarry, and formerly of Waterloo, Que., died recently. When a young man he entered the lumber business, and later on took up marine diving, inspecting steamers in Montreal harbor for some years. Subsequently he opened up the marble quarries at Philipsburg and South Stukely, Que.

Mr. W. G. Mackendrick, of the Warren Bituminous Paving Company, has been made a Captain in the British Army. Mr. Mackendrick went to England and offered his services to the Government in any capacity. He was granted the rank of Captain and sent to France in connection with roadway work, for which he is well qualified by experience and training.

It is doubtful if any corporation in Canada has supplied a larger number of recruits for military service in proportion to the size of its staff than has the Nova Scotia Steel and Coal Company, 721 of whose employees have volunteered for military service in various units. This number is equivalent to about forty per cent. of those in the employ of the company who are of military age.

Filion & Freres, Limitee, is the name of a company incorporated recently at Montreal "to undertake the construction of structures, buildings of all kinds, roads, streets, ways, canals, wharves, sewers, aqueduct systems, warehouses, and other works of a similar nature." Those interested are D., A., O., and J. Filion and A. Laverdure, all of Montreal. The capital stock of the company is $49,000.

The annual meeting of the Bricklayers' Union, Regina branch, was held on the 11th inst., and the following officers were elected for the ensuing year: president, G. Somerseiles; vice-president, J. Baggalay; financial secretary, George Alley; treasurer, J. Farmer. The membership of the Regina local has been well maintained, largely owing to the fact that a number of large buildings have been erected in the city during the season.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Aldborough Township, Ont.
The Township Council will shortly commence the construction of the Cahill, Mumford and Watson Drains. Clerk, E. A. Hugill, Rodney.

Brockville, Ont.
The Town Council will have plans prepared for the diversion of the Thames Street sewer. Engineer, G. H. Bryson.

Elma Township, Ont.
The Township Council intend to proceed with the construction and improvement of the Peet Drain. Clerk, George Lochead, Atwood.

Leamington, Ont.
The Town Clerk, R. M. Selkirk, will receive tenders until March 10th for the construction of approximately 16,000 square yards of concrete pavements. Plans at offices of the Clerk and the Engineer, J. J. Newman, C. E., Windsor.

London, Ont.
The City Council have decided to have plans prepared for asphalt pavement to be laid on Dundas Street E. Estimated cost, $30,000. Engineer, H. A. Brazier.

The City Council propose to lay an asphalt pavement on Beaconsfield Avenue and will shortly call for tenders on the supply of tile for sewer purposes. Engineer, H. A. Brazier.

Plans are to be prepared for the construction of an 8-inch sewer on Linwood Street for the City Council. Engineer, H. A. Brazier.

Moncton, N.B.
The Town Council contemplate laying a pavement on Main Street and propose to issue bonds for this purpose. Clerk, J. S. Mager.

Scarboro Township, Ont.
The Township Council will shortly commence the laying of watermains on Queen and Victoria Streets and Windsor Avenue. Engineer, F. Barber, 57 Adelaide Street E., Toronto. Estimated cost, $5,000.

Tillsonburg, Ont.
The Town Council are considering the laying of sewers to the buildings used by the soldiers, and the installation of shower baths. Particulars from Councillor Conn.

CONTRACTS AWARDED

Montreal, Que.
The contract for the installation of a pump at the Papineau Avenue Pumping Station has been let by the City Council to Canadian Allis-Chalmers Ltd., Rockfield, Que.

Sarnia, Ont.
The City Council have awarded a contract for the construction of vitrified sewers to P. Corrigan, 410 Brock Street.

Railroads, Bridges and Wharves

Calgary, Alta.
The City Council propose to call for tenders on the supply of 342 tons of steel required for the completion of the Centre Street Bridge. Clerk, J. M. Miller.

Detroit River.
The Department of Public Works, Ottawa, have provided in their estimates for channel improvements between Fighting Island and the Canadian Side, estimated to cost $57,000. Secretary, R. C. Desrochers.

Public Buildings, Churches and Schools

British Columbia Province
The Dominion Government Department of Public Works have provided in their estimates for the erection of the following buildings :— Merritt, Public Building, $25,000; Mission City, Public Building, $20,000; New Hazelton, Drill Hall, $9,000; Penticton, Public Building, $15,000; Powell River, Public Building, $20,000; Prince Rupert, Quarantine Station, $8,000, Public Building, $147,000; Revelstoke, Public Building, $50,000; Sidney, Public Building, $17,000; South Vancouver, Post Office, $60,000; Trail, Public Building, $20,000; Vancouver, Postal Station, $124,000, Drill Hall, $94,000, Detention Building, $55,000; William Head, Quarantine Station, $75,000.

Orangeville, Ont.
Dufferin County Council have authorized the County Clerk to call for tenders on re-wiring the Court House and Registry Office to comply with Standard Regulations. Clerk, J. C. Reid.

Orford Township, Ont.
Tenders on the erection of a school for the Trustees of School Section No. 7 will be received until March 10th by the Secretary, J. D. Anguiss, Muirkirk. Pressed brick construction. Estimated cost, $5,000.

Peace River, Alta.
The Presbyterian Congregation have purchased a site for a church and work will start in the spring. Pastor, Rev. W. Granan.

Peace River Crossing, Alta.
The Town Council are considering the erection of a Municipal Office and Fire Hall; but may not start work for two months. Secretary, L. W. Divine.

Stamford Township, Ont.
The Trustees of School Section No. 2 have decided to build a school and will call for tenders shortly. Plans are being prepared by J. Upper Collins, 49 Benson Street, Niagara Falls.

St. Marie, Que.
Repairs to the Roman Catholic Church are being considered. Work will include new roofing and installation of an electric lighting system. Estimated cost, $25,000. Curate, J. E. Feuiltaut.

St. Pacome, Que.
The installation of a heating system at the Parish Church is being considered Curate, Rev. A. Caron.

Strathroy, Ont.
Work will start in the spring on alterations to the Methodist Church. Work will include installation of a steam heating plant, painting and seating. Pastor, Rev. A. E. Jones. Estimated cost, $5,000

Sydney, N.S.
The School Board are considering the erection of an addition to the Argyle Street School. Chairman, W. A. Richardson.

Toronto, Ont.
In connection with the Administration Building which has been erected on College Street for the Board of Education, the sum of $5,000 for electric fixtures and furniture has been included in the estimates and passed. Secretary, W. C. Wilkinson.

Property Vommissioner Chisholm has reported to the Board of Control that $60,000 will be required for steel filing cabinets and electric fixtures for the Registry Office. Plans are now being prepared by the Architect, C. S. Cobb, 71 Bay Street.

Trail, B.C.
The erection of an addition to the school is being considered by the School Board. Secretary, Walter Cody. Estimated cost, $15,000.

Walkerville, Ont.
The Congregation of the Presbyterian Church are considering the erection of a Sunday School building at an approximate cost of $8,000. Pastor, Rev P Taylor.

West Salisbury, Alta.
The Trustees of West Salibury School District propose to build a brick school in the spring. Particulars from the Secretary-Treasurer.

CONTRACTS AWARDED

Fredericton, N.B.
The contract for the installation of customs fittings has been awarded by the Department of Public Works, Ottawa, to J. T. Schell Company, Kenyon Street, Alexandria, Ont.

Ottawa, Ont.
The Carleton County Council have let the contract for plumbing at the County Jail to McKinley & Northwood, Rideau Street. Electrical work not yet let

Business Buildings and Industrial Plants

Cobalt, Ont.
Work by day labor has been started

on the erection of a hotel for J. O'Connor. Estimated cost, $15,000.

Dundas, Ont.
Ellis & Oborne are preparing plans for a brick store and residence to be erected on King Street for Harry Cohen, King Street. Estimated cost, $3,500.

Edmonton, Alta.
The Great West Garment Company, 10438 97th Street, propose to build an addition to their factory.

Elmira, Ont.
Tenders are now being received for the erection of a business block on Arthur Street for William Moser. Architect, J. McMillan. White brick construction, cement foundation, corrugated roofing. Approximate cost, $4,000.

Halifax, N.S.
Tenders on the construction of janitor's quarters inside the market building are being received by the engineer, Major Doane, City Hall. Estimated cost, $4,500. Architect, S. P. Dumaresq, St. Paul Building.

Hamilton, Ont.
The Automobile Owner's Association, 108 King Street W., propose to erect a garage shortly.

Highgate, Ont.
George Oakes proposes to rebuild his store, which was recently gutted by fire.

Lindsay, Ont.
The work required in the construction of a chemical plant for T. Hodgson, 9 Tecumseh Street, Orillia, will be done under the supervision of the owner. Work will start in April.

Montreal, Que.
The Canada Car & Foundry Company, 120 St. James Street, are about to make repairs to their foundry and machine shop, and will employ their own staff.

North Vancouver, B.C.
Tenders are now being received for the construction of the main buildings for the projected plant of the Vancouver Creosoting Company. Engineer, J. C. Storey.

Quesnel, B.C.
The following parties have decided to rebuild their premises, destroyed in the recent fire:—Bank of British North America, Strand Hotel, Occidental House, Vaughan Realty Company, John Fraser Company, Cowan Supply Company.

Spirit River, Alta.
Platzer & Eckler have commenced the erection of a hotel and livery barn, estimated to cost $3,500.

St. Catharines, Ont.
In connection with the factory which has been built for the Marathon Tire & Rubber Company, Limited, 45 King St., tenders are being received for the installation of a sprinkler system. Heating by owners.

Stratford, Ont.
Work will start in the spring on the erection of an addition to the factory of the McLagan Furniture Manufacturing Company, 93 Trinity Street.

St. Thomas, Ont.
The St. Thomas Pure Milk Company propose to erect a new plant, at an approximate cost of $10,000. Manager, Alexander Anderson.

Tilbury, Ont.
The Crawford Block has been purchased by Henry Benglet, Henry Hallot and J. A. Magee, and will be converted into three stores.

Toronto, Ont.
Tenders are now being received for alterations to the old Central Prison building, Strachan Avenue, for the W. K. Kellogg Cereal Company, Battle Creek, Mich. Local Representative, R. R. Thomson, Room E., Queen's Hotel.

City Architect, W. W. Pearse, City Hall, has prepared plans for a Fire Hall to be erected in the Wychwood District, and will call for tenders in a short time. Steel and brick construction.

Vancouver, B.C.
The erection of a picture theatre is contemplated by F. Gow, Broadway Theatre, 114 Broadway E. Estimated cost, $50,000.

In connection with the addition which is being erected at the premises of the American Can Company, 535 Railway Street, tenders will be called shortly for the installation of heating, electrical work and elevators. Plans and specifications at office of the Company.

Plans have been prepared for a large shed to be erected for the Department of Public Works, Ottawa. British Columbia fir construction, composition roofing. Secretary, R. C. Desrochers.

CONTRACTS AWARDED

Brandon, Man.
G. W. Vincent, 716 Rosser Street, has let the contract for repairs to his stores to Higgins Bros. Approximate cost, $16,000.

Fort Erie, Ont.
The contract for electrical work required in connection with the bakery and residence which has been built for E. Hawkins has been let to George Mann, Fort Erie.

Hamilton, Ont.
The Tallman Brass Company, Wilson Street, have let the contract for laying 2,000 square feet of Sarco Mastic Flooring at their factory to the Construction Supply Company, Limited, Telephone Building, Toronto.

Montreal, Que.
The general contract for repairs to the stores and offices at 238 St. James Street has been awarded to George Roberts, 79 Lagauchetiere Street. No sub-contracts will be let. Approximate cost, $4,000.

In connection with the alterations now being carried out at the planing mill of P. E. Bourassa, 1495 Notre Dame Street W., the contract for electrical work has been let to Pepin & Normandin, 668 Mount Royal Avenue E.

Ottawa, Ont.
S. McClennaghan, Bank and Sparks Streets, has let the contract for alterations to his premises to Garnet Douglas, 382 Waverley Street.

Sherbrooke, Que.
The contract for painting in connection with the addition to the market building has been let by the City Council to O. Lesperane, 29 Council Street.

Spirit River, Alta.
The general contract for the erection of a store and warehouse for Race, Hunter & Giddy has been let to W. Wade. Frame construction.

W. Wade has been awarded the contract for the erection of a hotel on First Avenue. Frame construction. Owner's name withheld.

Toronto, Ont.
Work has been started on alterations to a store at 130 Yonge Street for J. J. Fallett, 132 Yonge Street. The contract for store front has been awarded to H. J. St. Clair Company, Limited, 27 Yonge Street Arcade. Contracts for interior decoration, fixtures, show cases, etc., will be let by the tenants, Page & Shaw, Ltd., 610 St. Catherines Street W., Montreal.

The general contract for alterations to the premises of the Sheet Metal Products Company of Canada, Ltd., 199 River St., has been let to Brown & Cooper, Ltd., 297 Carleton Street. Steel and brick construction. Estimated cost, $20,000.

Work has been started on repairs to the store at 68 Queen Street West for the A. Manning Estate, Manning Arcade. Contractor, S. B. Bagshaw, 477a Marion Street.

The contract for the masonry required in the erection of an addition to the factory of the Carhartt Hamilton Manufacturing Company, 535 Queen Street E., has been let to F. W. Wedle, 35 Lindsay Avenue. Brick construction, felt and gravel roofing. Estimated cost, $4,000.

Work has been started on alterations to a building at 146 Bay Street for the Dominion Automobile Company, 145 Bay Street. The general contract has been let to R. G. Kirby, 539 Yonge Street, and the masonry to R. Chalkley & Son, Ltd., 34 Victoria Street.

Vancouver, B.C.
In connection with the addition to the factory of the American Can Company, 535 Railway Street, the contract for painting has been let to A. V. Lewis, 1202 Seventh Avenue W., the mill work to Cornish & Cooper, Dufferin Street, and the glass work to Bogardus Wickins & Begg, Ltd., 1000 Homer Street.

Residences

Corinth, Ont.
T. Ford is considering the rebuilding of his residence, which has been completely destroyed by fire.

Hensall, Ont.
W. Dickson, Main Street, is preparing plans for a residence, estimated to cost $3,000. White brick construction, stone and concrete foundation, shingle roofing.

Lindsay, Ont.
L. V. O'Connor and J. O'Reilly are considering the erection of two residences on Queen Street. Red brick construction, stone foundation, shingle roofing.

London, Ont.
Plans are being prepared for a residence to be built for John Putherbough, 1006 Wellington Street. Architects, Watt & Blackwell, Bank of Toronto Building. Tapestry brick construction, slate roofing. Estimated cost, $5,000.

Montreal, Que.
S. Frappier, 2238 Park Avenue, has

prepared plans for a residence to be erected on Belmore Avenue for Louis Clement, 338 Garnier Street. Tenders will be called shortly. Brick construction, concrete foundation, felt and gravel roofing. Approximate cost, $5,000.

Orangeville, Ont.
John Wilson, Architect, Collingwood, Ont., is preparing plans for a residence to be erected for Judge Fisher, at an approximate cost of $3,500. Denison interlocking tile construction.

Ottawa, Ont.
Bower Bros., 133 Hopewell Avenue, have commenced the erection of two residences on Ossington Avenue, estimated to cost $4,500 each. Brick veneer construction, stone foundation, shingle roofing.

Frank Cowan, 1110 Somerset Street, is considering the erection of a residence on Bethany Road. Brick veneer construction, stone foundation, shingle roofing. Estimated cost, $4,000.

The erection of a number of residences in the West End is being considered by J. Villeneuve, 164 Bayswater Avenue. Brick veneer construction, stone foundation, shingle roofing. Estimated cost, $3,800 each.

J. Slack, Riverside Park, Ottawa West, contemplates the erection of a residence on Huron Avenue. Brick veneer construction, stone foundation, shingle roofing.

W. C. Leech, 140 Spadina Avenue, contemplates the erection of several residences on Bethany Road, at an approximate cost of $4,000 each. Brick veneer construction, stone foundation, shingle roofing.

Leon Petregorsky, 87 Goulbourne St., has commenced the erection of apartments at Laurier and King Streets, estimated to cost $8,000. Brick construction, stone foundation, felt and gravel roofing.

Quebec, Que.
George Montmagny, 312 Bagot Street, has commenced the erection of a residence on Napoleon Street, estimated to cost $3,000. Frame and brick construction, felt and gravel roofing.

Work has been started by J. Julien, 239 Ste. Helene Street, on the erection of a residence on Fifth Avenue, Domaine Lairet. Frame and brick construction, metal and asbestos roofing. Estimated cost, $6,000.

J. E. Tremblay, 20 St. Nicholas Street, has commenced the erection of a residence on Fourth Avenue, Limoilou. Brick construction, felt and gravel roofing. Estimated cost, $5,000.

Shallow Lake, Ont.
Dr. Howes is considering rebuilding his residence, recently destroyed by fire.

Stayner, Ont.
Plans of a residence to be built for T. A. McDonald are being prepared by John Wilson, Collingwood. Tenders will be called upon completion of plans. Pressed brick construction.

St. John, N.B.
Gandy & Allison have completed the Van Guilder concrete house on Lancaster Avenue, and propose erecting three more self-contained dwellings as soon as weather conditions permit. They will take quotations on dimension lumber, hardwood flooring, metal lath, hot water heating, etc. Plans at their office, 3 and 4 North Wharf, St. John, N. B.

Toronto, Ont.
L. Speirs, 94 Glenholme Avenue, is about to erect a residence, estimated to cost $3,500. Smaller trades will be sublet. Brick construction, shingle roofing.

A. A. Mitchell, 502 Palmerston Boulevard, is about to erect a pair of two-family residences at Gormley and Lawton Streets. Smaller trades will be let. Brick construction, shingle roofing. Estimated cost, $6,500.

CONTRACTS AWARDED

Forest, Ont.
Work will start shortly on the erection of a bungalow for Mrs. George Webster. General contractor, Phil Prouse. Milton pressed brick construction, concrete foundation, felt and gravel roofing. Estimated cost, $3,000.

Ottawa, Ont.
Work is progressing on the erection of two residences on Ossington Avenue for H. L. Morrison, 15 Ossington Avenue. The general contract has been let to Bower Bros., 133 Hopewell Avenue, the plastering to R. J. Patterson, 66 Rosedale Street, and the heating and plumbing to Gervin & Lillico, 1093 Bank Street. Approximate cost, $4,000 each.

The contract for electrical work required in connection with the residence which has been erected on Grove Street by McCallum, 54 Glen Avenue, has been awarded to W. McCallum, 525 Bank St.

In connection with the apartments which are being built at Laurier and King Edward Streets for J. S. Wilson & Petregorsky, 256 Kent Street, the roofing contract has been let to J. Carnochan, 151 Fifth Avenue, and the heating and plumbing to Coldrey & Chapman, 330 Rideau Street. Plastering by day labor. Painting and electrical work not yet awarded.

The following contracts have been let in connection with the residence built on Centre Street for F. Carl, care of McAuliffe Davis Lumber Company:— carpentry, J. H. Saunders, Westboro; plastering, A. Bowman, Gilmour Street; heating, J. Cameron, Lewis Street; plumbing, T. Walters, Booth and Somerset Streets; electrical work, A. L. Young, 225 First Avenue.

Quebec, Que.
C. E. Morissette Ltd., 208 Latourelle Street, have commenced repairs to the residence of Alfred Boivin, 27 Notre Dame Street. Approximate cost, $4,000.

Work has been started on repairs to a residence on Remparts Street for Rene Dupont, Clarendon Hotel. General contractors, E. Paquet & Company, 18 Couillard Street. Estimated cost, $3,000.

D. Maranda, 812 St. Valier Street, has commenced the erection of a residence on King Street for A. Drouin, 93 King Street. Estimated cost, $3,000.

The contract for roofing the residences which have been built on Dolbeau Street for A. Demeules, 174 Des Stigmates St., has been awarded to N. Barbeau, 36 Bridge Street. Painting by owner.

Toronto, Ont.
The contract for plumbing and heating required in connection with the residence in course of erection on Astley Avenue for C. F. Fell, 66 Ravina Crescent, has been awarded to McNaughton & MacKenzie, 1029 Shaw Street, and the wiring to Hall & Dollery Electric Company, 457 Delaware Avenue.

Power Plants, Electricity and Telephones

Amherstburg, Ont.
The Town Council are considering the installation of a street lighting system. Clerk, G. E. Pulford.

Craik, Sask.
The Bennett Rural Telephone Company have been empowered to borrow $3,000 for the construction of their system. Secretary, L. M. Bennett, Craik.

Brussels, Ont.
The Brussels, Morris & Grey Telephone Company propose to make extensive improvements to their system in the spring. Secretary, M. Black.

Forest, Ont.
The People's Telephone Company are considering improvements and extensions to their system. Secretary, William Lawrie.

Grand Valley, Ont.
A by-law to authorize the installation of a hydro electric system will be submitted to the ratepayers on March 14th. Town Clerk, J. A. Richardson.

Kindersley, Sask.
The Clover Hill Rural Telephone Company, Limited, have been authorized to borrow $7,500 for the construction of their system. Secretary, Oscar Davis, Kindersley.

Maidstone Township, Ont.
The Township Council propose to make extensions and other improvements to the telephone system. Clerk, W. R. Phillips, Essex, Ont.

Noelville, Ont.
W. G. Daoust will start work in the spring on the construction of eighteen miles of telephone lines. Prices are being received on telephone equipment.

Rockhaven, Sask.
Permission has been granted to the Rockhaven Rural Telephone Company, Limited, to borrow $4,500 for the construction of their system. Secretary, W. B. Cruikshank.

South Churchbridge, Sask.
Permission has been granted to the South Churchbridge Rural Telephone Company, Limited, to borrow $3,000 for the construction of their system. Secretary, A. T. Penwarden.

Stratford, Ont.
The R. M. Ballantyne Company, Limited, propose to make an addition to their power plant.

CONTRACTS AWARDED

Petrolia, Ont.
The Town Council have let the contract for equipment for the transformer station to the Westinghouse Company, Limited, Hamilton.

St. Thomas, Ont.
The Hydro Electric Commission, City Hall, have let the contract for the supply of two transformers to the Canadian General Electric Company, 212 King St. W., Toronto.

Fires

Campbellford, Ont.
The plant of the Northumberland Paper & Electric Company has been entirely destroyed by fire. Loss is covered by insurance.

Carberry, Man.
The grist mill owned by J. E. McCormack has been entirely destroyed by fire. No insurance was carried.

Cobden, Ont.
Fire has destroyed the stores owned by J. McDermott, Main Street. Loss, $6,500.

Eastview, Ont.
The residence of Charles Aubry, Main Street, has been destroyed by fire. Loss, $3,500, partially insured.

Edmonton, Alta.
Fire has destroyed the Emery Block, owned by J. Ramsay, First Street. Loss, $25,000, covered by insurance.

Fairbank, Ont.
Fire has destroyed residences at 32 and 36 Fairbank Avenue, owned by William Harris and Robert Blair. Loss, $1,300 and $2,000 respectively. Frame construction.

Fenelon Falls, Ont.
The stores owned by Frank McGee and John Slater have been destroyed by fire. Owners may rebuild.

Frobisher, Sask.
Fire has completely destroyed the school. Loss, $8,000, covered by insurance.

Granby, Que.
Fire has badly damaged the factory of R. B. McComiskey & Company. Loss partly covered by insurance.

Guelph, Ont.
Fire has destroyed the stores belonging to L. E. Rowen. Loss is covered by insurance.

Hull, Que.
Fire has destroyed a tenement building at St. Laurent and Maisonneuve St., owned by I. Zumor. Loss, $16,000; insurance, $8,000.

Ingersoll, Ont.
The purifier of the Ingersoll Gas Light Company, Charles Street, has been destroyed by an explosion.

Kedgwick, N. B.
The lumber mill of the Richards Manufacturing Company has been entirely destroyed by fire. Plans are being prepared for rebuilding on a larger scale.

Keene, Ont.
The residence of C. W. Ross has been totally destroyed by fire.

Kelowna, B.C.
Fire has totally destroyed a residence at Glenwood Avenue and Richter Street owned by W. Chawford. Loss, $10,000, partially insured.

Loretteville, Que.
The sawmill owned by Joseph Boule has been destroyed by fire. Loss, $6,000, no insurance. Owner will rebuild and will require machinery.

Little Bras D'Or, N.S.
The colliery engine house, briquette plant and mine head, owned by the Colonial Mine Company, have been totally destroyed by fire. Loss, $50,000. Manager, G. B. Burchell.

MacLeod, Alta.
The Hotel Alamo, owned by Mrs. Griffith, has been destroyed by fire. Loss, $10,000, partially insured.

Matane, Que.
The residence and offices belonging to J. Lyons, Matane, have been destroyed by fire. Loss is covered by insurance.

Middle Sackville, N.B.
The residence of Rev. A. V. Landry has been partially destroyed by fire. Loss, $2,000, covered by insurance.

Montreal, Que.
Fire has damaged the premises and plant of the Canada Car & Foundry Company, 120 St. James Street, to the extent of about $25,000.

Fire has damaged the premises at 60 St. Paul Street W., to the extent of about $5,000. Owners, Masson Estate, 13 St. James Street. Repairs will be made at once by the owners.

The kitchen, lunch room and restaurant of the Hotel Prince, Windsor and St. Antoine Streets, have been destroyed by fire, causing a loss of about $7,000. The owner, Joseph Pullam, 858 Tupper Street, will call for tenders on repairs.

North Battleford, Sask.
Fire has destroyed the school belonging to the Roman Catholic School Board. The loss is heavy.

Ottawa, Ont.
The warehouse of the Grant-Holden-Graham Company, Limited, Albert St., has been destroyed by fire. Loss, $200,000.
Fire has destroyed the main block of the Parliament Buildings. Estimated loss, $3,000,000.

The residence of D. Tuffey, Main St., has been destroyed by fire. Loss, $3,500.

Quebec, Que.
The factory on Desprairies Street, owned by the G. A. Vandry Biscuit Company, has been badly gutted by fire. Loss, $42,000, covered by insurance.

Fire has destroyed the biscuit factory owned by G. A. Vandry, 50 Ste. Ursule Street. Loss, $42,000, covered by insurance.

The offices and freight shed of the Quebec Central Railway have been destroyed by fire. Loss is covered by insurance. Local Agent, F. S. Stocking.

Fire has damaged the offices and baggage rooms of the Quebec Central Railway to the extent of about $10,000. The company may rebuild. Head offices, Sherbrooke, Que.

Ste. Sabine Station, Que.
The hotel has been destroyed by fire. Owner, W. Brousseau, Ste. Sabine Station.

Tomstown, Ont.
The Hotel, owned by Tough & Smith, has been completely destroyed by fire.

Toronto, Ont.
The premises of S. Levinter, 413 Queen Street, have been damaged by fire to the extent of about $7,000.
Fire has gutted the American Club, Wellington Street. Secretary, A. H. McNeal, 17-19 Wellington Street West.

Valleyfield, Que.
Fire has destroyed the Methodist Church. Loss, $7,000. The edifice will be rebuilt. Stone and brick construction. Pastor, Rev. J. A. Crane.

Miscellaneous

Belmont, Ont.
The Belmont Oil Company, care of William Barrons, will start drilling for oil and gas as soon as possible.

Brantford, Ont.
Fire Chief D. J. Lewis has recommended the purchase of one motor tractor, one motor steam engine, re-wiring the alarm system and installation of a new heating system at the fire hall.

Davidson, Sask.
Prices and other information with regard to the following materials are being received by D. Wilkie:—air compressor, store fronts, steam and hot water boilers, wood paint, plumbing fixtures, garage equipment and accessories.

Halifax, N.S.
The City Clerk, L. F. Monaghan, will receive tenders until noon, February 29th, on the supply of 2,000 feet of 2½-inch fire hose and 300 feet of 1-inch chemical hose, with couplings.

Kincardine Township, Ont.
The Township Clerk, John Corbett, Armow, Ont., will receive tenders until March 8th for the supply of tile required during the year.

Kingston, Ont.
The City Engineer, R. J. McClelland, will receive tenders until 3.30 p.m., February 25th, for supply of the following materials during the year:—portland cement, lumber, hardware, rubble stone, sand, sewer pipe, manhole covers, light-hole covers and street grates. Specifications at office of the Engineer.

London, Ont.
The City Council will shortly call for tenders on the supply of cement required during the year. Engineer, H. A. Brazier.

Montreal, Que.
The Board of Commissioners will receive tenders until noon, March 2nd, for the supply of 6,000 tons (more or less), of refined asphalt. Specifications at office of the Superintendent of Purchases and Sales.

Nilestown, Ont.
James Grieves, Keyser, Ont., is considering the installation of new equipment in the disused cheese factory. Estimated cost, $6,000.

Springbank, Ont.
The Springbank Creamery Company propose to instal cheese factory equipment at an approximate cost of $5,000. Particulars from W. L. Wallace, Fordwich, Ont.

(Continued on page 48)

Tenders and For Sale Department

Tenders for Paving

Paving tenders are called for, to be in by **March 10, 1916**, for Reinforced Concrete Pavement, for 3,869 square yards on Russell Street; 3,913 square yards on Mill Street; 8,314 square yards on Talbot Street; together with the necessary excavation, curbs, etc. Plans and specifications at the office of J. J. Newman, C. E., Windsor, Ont., and at the office of the Town Clerk. Address tenders to the undersigned.

R. M. SELKIRK, Town Clerk.
Dated, Leamington, Feb. 17, 1916. 8

Tenders for Radial Brick Chimney

Bulk tenders will be received, by registered post only, up to noon on **Tuesday, March 7th, 1916**, for furnishing and constructing Radial Brick Chimney and Foundations for the Refuse Incinerating Plant on Don Roadway, Toronto. Tenders must be addressed to the Chairman of the Board of Control, City Hall, and be plainly marked on outside of envelope, "Tenders for Radial Brick Chimney for Refuse Incinerating Plant." Specifications and forms of tender may be obtained from the office of the Street Commissioner, City Hall. Parties tendering must comply strictly with conditions of City By-law, as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
8-8 Chairman Board of Control.

Tenders for STREET CARS

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, March 14th, 1916**, for the supply and delivery of:

	Tender Numbers
One single-truck double-end street car, completely equipped, ready for operation, for Bloor Street Division, Toronto Civic Railway	37
One car body, double-end, single-truck, for Bloor Street Division, Toronto Civic Ry.	37-A
Equipment for one single-truck for Bloor Street Division, Toronto Civic Railway, electrical equipment	37-B
Equipment for one single-truck car for Bloor Street Division, Toronto Civic Railway, single-truck	37-C

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of city by-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
7-7 Chairman, Board of Control.

Department of Railways and Canals, Canada

Dartmouth Branch Line
BUILDINGS

Notice to Contractors

Sealed tenders addressed to the undersigned and marked "Tender for Buildings on the Darmouth Branch Line," will be received at this office until 12 o'clock noon on **Wednesday, March 15th, 1916.**

Plans, specifications and form of contract to be entered into can be seen on or after this date at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa, at the office of the Chief Engineer, Canadian Government Railways, Moncton, N.B., and at the office of the Engineer in Charge, Dartmouth, N.S.

An accepted bank cheque on a chartered bank of Canada for an amount equal to ten per cent. of the total sum tendered made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sum will be forfeited if the party tendering declines entering into contract for the work, at the rates stated in the offer submitted.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

J. W. PUGSLEY,
Secretary.
Department of Railways and Canals.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.- 92982. 8-9

WE ARE IN THE MARKET

for new or second-hand Aluminium Cable or Wire in any size. Samples should accompany offers, with price and quantity.

Box 315, Electrical News, Toronto, Ont.
8-9

Late News Items

Bathurst, N.B.
The stores owned by W. J. Kent & Company have been destroyed by fire. Loss, $200,000; insurance, $90,000.

Beadle, Sask.
Tenders on the construction of the proposed system of the Beadle Rural Telephone Company will be received until March 1st by the Secretary, J. Buckingham, Beadle. Plans and specifications at office of the Secretary and of the Department of Telephones, Regina.

Bishop's Crossing, Que.
Tenders on the erection of a school are being received by the Secretary to the School Board, H. Cunningham. Frame and brick construction. Estimated cost, $5,000. Architect, H. R. Bishop.

Quebec, Que.
Work has been started on the construction of stock yards, stables and other buildings for the Quebec Abattoir Company, Limoilou. The general contractor is J. Gosselin, 96 St. George St., Levis. Approximate cost, $35,000.

St. Albans, Que.
D. Beaubien, 28 Royal Insurance Company Building, Montreal, will receive tenders for the installation of the following 500 h.p. unit for the Portneuf Hydro Electric Company, Portneuf, Que.:—one vertical water wheel, one generator, one switchboard and general equipment.

Stanstead, Que.
Work has been started on the erection of a factory for G. & G. Ltd., Stanstead. The general contract has been let to Loomis, Dakin, Ltd., St. Gabriel Street, Sherbrooke. Metal siding construction, concrete foundation, felt and gravel roofing. Approximate cost, $15,000.

Sydney, N.S.
Tenders are being received by the Secretary to the Knights of Columbus for the erection of a hall in either frame or concrete construction. Architect, R. A. Frechette, 30 Bonnacord Street, Moncton. Estimated cost, $8,000.

Torquay, Sask.
A. G. Vinge, Torquay, will receive tenders until noon, March 10th, for the construction of the Marienthal Rural Telephone Company's proposed system. Plans and specifications at Department of Telephones, Regina, and at office of Mr. Vinge.

Vancouver, B.C.
Tenders will be received until noon, March 6th, by the Purchasing Agent, James Stuart, for the supply of cement, sand, gravel and castings during the year.

Strauss Cantilever Swing Bridge

During the past fifteen or twenty years improvement in movable bridges has been confined largely to the very great advances in bascule design. More recently the vertical lift type has also undergone extensive development. The swing bridge or horizontal draw type, however, has received comparatively little attention. J. B. Strauss, consulting engineer, Chicago, whose last contributions to bridge engineering was the counterbalanced lever lift bridge, has now developed a swing bridge which lays claim to much originality.

This design, known as the Strauss cantilever swing bridge, departs radically from all existing types, while at the same time having no elements which are unknown and untried. Its characteristic features are: First, the use of direct driven trucks running upon ordinary railroad rails to effect rotation; and second, the construction of the central portion of the draw span as a cantilever projecting beyond the centre pier with the arms pin-connected at their ends so as to constitute simple spans from the ends of the cantilever to the abutments.

Miscellaneous

(Continued from page 44)

Tilbury, Ont.
The Union Natural Gas Company, Sarnia, propose to lay a ten-inch steel gas main between Tilbury and Sarnia. Work will start in the spring. Particulars from S. L. McKay, care of the company. Estimated cost, $30,000.

Toronto, Ont.
The Board of Control will receive tenders until March 14th on the supply of one single truck double end car and one single truck double end car body, with electrical equipment. Specifications at Room 12, City Hall.

The Board of Control will receive tenders until March 7th for the construction of a radial brick chimney at the Don Roadway Incinerating Plant. Plans and specifications at office of the Street Commissioner, G. B. Wilson.

Vancouver, B.C.
The Canadian Pacific Railway Company, Montreal, contemplate the installation of a fifty-ton electric crane at Burrard Inlet.

CONTRACTS AWARDED

Niagara Falls, Ont.
The City Council have let the following contracts for waterworks supplies:—brass work, Mueller Manufacturing Company, Sarnia; hydrants, Doherty Manufacturing Company, Sarnia; gate valves, James Morrison Brass Manufacturing Company, 93 Adelaide Street W., Toronto.

Committee Advocates Mortar Bed for Wood Blocks

A mortar bed for wood-block paving, instead of a sand cushion, is recommended by Clyde H. Teesdale, H. S. Loud and Frank Cherrington in their committee report submitted at the annual meeting in Chicago of the American Wood Preservers' Association. A 1:4 mixture, brought to a thickness of from ½ to 1 in. by templates, and containing just enough water to insure a proper setting of the cement, is advocated. The intention is to produce a granular mixture which may be raked to the desired grade.

Under certain conditions, especially where vibration may be expected, the committee report specifies that a mortar cushion may be omitted and a bituminous coating of one or two thicknesses, spread upon the smoothly finished and thoroughly dry concrete base, substituted therefor. A bituminous filler for the joints is recommended.

In another report to the same association Mr. Cherrington gave the results of a circular letter requesting information as to wood block paving practice in a number of cities. Of 155 cities circularized replies were received from seventy-nine. The majority called for a bituminous filler, with pitch having a slight advantage over asphalt. The fafored cushion is shown to be about equally divided between sand and mortar. The heavy creosote is by far the most popular preservative oil.

The data show that very few cities install the blocks by ramming the rows or courses tightly together. Most of the pavements are laid with the blocks in slight contact or by leaving interstices of at least one-eighth of an inch between the ends of the individual blocks. A large majority advocate laying the blocks at an angle of 90 degs. with the curb line.

Slipperiness of wood block pavement is retarded, up to six per cent. grades, with either lug blocks, creosoted lath strips or beveled blocks. Very few cities specify expansion joints transversely; most of them require a 1-in. joint parallel and adjacent to each curb. These expansion joints are filled with asphalt, pitch, fiber or sand, the preference being in the order named. In only two instances was a cement grout filler specified for wood blocks.

Excavation to Backfill in One Handling via the Roof

In the east portal of the Twin Peaks tunnel which the city of San Francisco is constructing as a municipal venture, a considerable length of the concreting was done in open cut. It was found that the last of the excavation in this section could be expedited and that at the same time the work of backfilling on completed parts of the concrete arch could be cheapened by cutting through the arch and delivering muck direct to the backfill with one handling, using an inclined railway through the finished roof.

Loaded dump cars were delivered by gravity to the foot of the incline on the right, were drawn up by an electrically-driven endless-chain belt, and after being dumped in fill were returned empty down the incline on the left. About 10,000 cu. yds. of material were handled over this incline improvised after the work was under way. In making the openings in the arch roof the reinforcing was left in place so that the sections could be readily restored to normal.

While mucking was in progress the electric motor ran continuously, cars being handled at about five-minute intervals. The link belt operated by this motor carried dogs which engaged steel brackets riveted to the running gear of the dump cars, so that the mechanism required no attention at either end of the incline. From the top a slight descending grade delivered the cars to the dump by gravity. On the return incline the link belt, which was not provided with power, was controlled by a hand-operated friction brake working on the shaft that carried the link belt sprocket at the head of the incline.

The most important problem that had to be solved in getting the scheme to work satisfactorily was the proper grades for the inclines. The grades first selected were too steep and a reconstruction of the track was required. As finally adopted the ascending grade was made 28 per cent. and the descending grade 40 per cent. The cars handled had a capacity of 1½ cubic yards.

The work is being done under the direction of M. M. O'Shaughnessy, city engineer. The escalator was designed and built by the contractors, R. C. Storrie & Company, of San Francisco.

Steam engine indicators for determining governor effort have been employed successfully in the River Mill plant of the Portland Railway, Light & Power Company. Company engineers working on this problem concluded that simultaneous pressure records, secured on each end of the governor cylinder, form the most satisfactory basis of rating, because under test the conditions are identical with those of normal operation, and elaborate changes of the mechanism are unnecessary. Graphic record pressure gauges were used, equipped so as to increase the speed of chart travel and produce a record with appreciable length in the space required for the governor to operate through a considerable part of its travel. Charts were taken from indicators on each end of the governor cylinder so as to secure a continuous record on the cards of the varying pressures from each side of the governing piston throughout two complete strokes or one cycle of operation.

ESTABLISHED 1886

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Vol. 30 March 1, 1916 No. 9

Principal Contents

Good Roads Enthusiasm

MONEY wisely invested in providing good roads is one of the best legacies the people of today can leave to posterity. Good roads are an economic necessity, essential to all the phases of our social and commercial intercourse and a prime factor in the development of the province. The highways we have always had with us and always will. Upon them we meet with a common feeling of ownership and it is our duty to ourselves to improve our economic conditions by paying greater attention to the prosecution of highway improvements.

Road improvement is a matter of deep interest throughout the farming districts of the Dominion. Every journey is wholly or in part over the common road, and the comfort and prosperity of the agricultural community and, therefore, of the cities and towns, are closely reflected in road conditions.

Steam and electric railways are all-important. Yet neither of these does away with the necessity for good highways. They rather increase the demand. Railways bring development, and development means more people on the land, and more production, with an attendant greater use of local roads. Observation appears to bear out the statement that good highways are more generally found adjacent to steam roads or suburban electric lines.

Appreciating the necessity of the situation, a number of Canadian Good Roads organizations have for some years been endeavoring to accelerate the movement towards better highways by every means in their power and from the number of associations formed throughout the Dominion of Canada, the keen interest taken, and the enthusiasm shown, by the members of the associations, it is evident that substantial progress is being made. This is further evidenced by the greatly increased mileage of good roads throughout the Dominion. In Ontario, interest in the good roads movement has been further stimulated by the passage of the Macdiarmid bill which now, we believe, justifies this province in claiming that the road laws of Ontario are the best in the Dominion.

* * *

That the Canadian people are becoming educated and are realizing the benefits of good roads has been amply evidenced by the co-operative spirit reported throughout the various conventions recently held at many points in the Dominion. Among these may be mentioned the Conference on Road Construction for county superintendents and engineers recently held by the Ontario Department of Highways at the Parliament Buildings, Toronto, to promote a closer relationship between the engineers of the department and the county superintendents, and effect a more efficient prosecution of highway improvements. The recent successful meeting of the Ontario Good Roads Association, a report of which is printed in this issue, also clearly demonstrated the great advances that are being made all over the province of Ontario. In Alberta, at a recent convention, Mr. Charles Steward, Minister of Public Works, mentioned the decision of that province to lay before the provincial authorities a proposal for the appointment of a highway or good roads commission, as the best solution of the complex and difficult problem of providing the province not only with efficient and serviceable roads, but also with an effective road maintenance system. And last, there is the work done by the Manitoba Good Roads

Association and the Manitoba Government which, under the efficient direction of Archibald McGillivray, Comissioner of Highways, have completed 266 miles of roads out of 373 miles under construction. The progress of the Good Roads Movement in Manitoba is described by Mr. McGillivray in an article reproduced elsewhere in this issue. The good work of the Quebec Department of Roadways, which, under a most energetic management, has done wonders in the past two or three years, is also outlined in this number.

* * *

The climax is reached, however, in the interest being taken in the Third Canadian International Good Roads Association Congress to be held in Montreal, March 6 to 11. The consensus of opinion is that this International Congress is providing a long-felt want, as all evidence shows that the information provided at the last two congresses has been of inestimable value to those interested in improving and developing the roads of the Dominion.

Summed up, Good Roads are an absolute necessity if the country is to continue progressive and the evidence is that public opinion is being thoroughly aroused to the advantages of good roads so that development may proceed along the broad lines that are essential to the continued progress and prosperity of the Dominion. The success of the Good Roads Movement, however, still depends on further educating the public to its many great advantages, until they became convinced that every dollar wisely and efficiently spent for this purpose is an investment that will pay an interest in gold dollars, to say nothing of the added pleasure in life, the added pride the individual will feel in his surroundings and the added comfort during the hours actually spent passing up and down the highway.

Good Roads in War Time

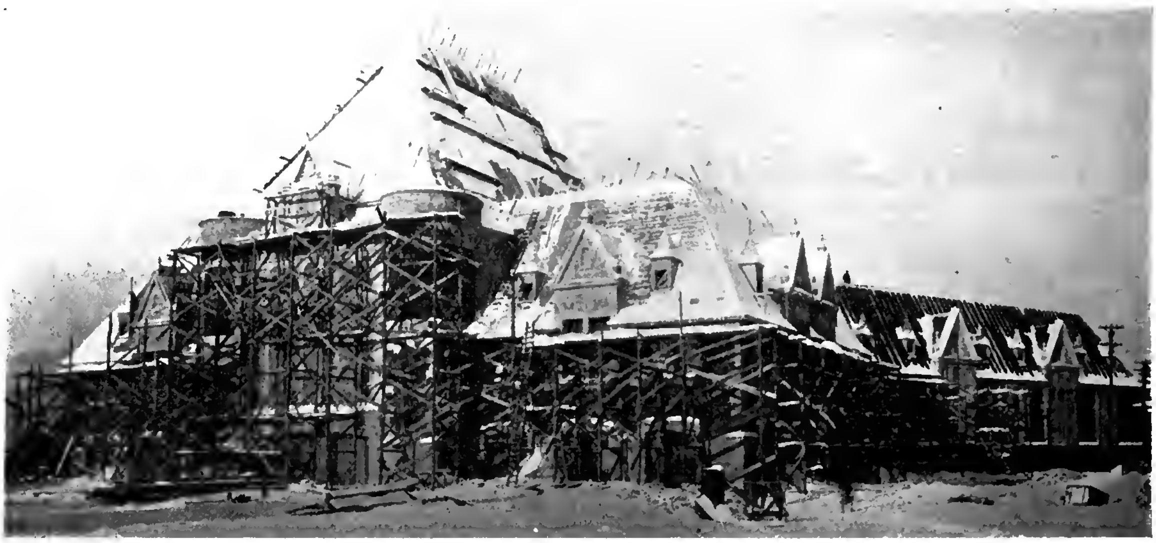
Canadians at this time should be specially interested in the address by Major Amos A. Fries, corps of Engineers, United States Army, on "The Value of Permanent Highways for National Defense," delivered at the Second National Conference on Concrete Road Building held in Chicago, February 15th, 16th, 17th and 18th, 1916. He urged the increased value of permanent roads under present methods of warfare where motor vehicles play such a prominent part. He declared that the use General Joffre made of motor cars and good roads around Paris in August 1914 saved the city and halted the German offensive. He spoke of the value to the United States of permanent roads along the coasts and land boundaries. Even when a considerable distance from the borders East and West roads would be of great value if North and South feeders were built as movements over them could be made without the knowledge of the enemy thus providing the surprise so essential to success.

Progress on Quebec Union Station

Considerable progress has been made in the construction of the Union Station, Quebec, by the contractors, W. S. Downing-Cook, of Montreal. The general plans of this building were shown in our issue of November 24, 1915. The exterior of the building is now practically completed; the power house is also completed, the boilers are in position, and the general building is under steam. The exterior is of Chateauvert stone, with Argenteuil granite. The window frames and iron doors are in place, and the exterior iron sashes ready for installation. The gypsum block covering is now on, and the roof has only to be sheathed and covered with copper.

In the interior the partitions are being made ready for the plastering; brick and facience work in the concourse has been started, and work will he commenced on the ticket lobby. The brick work here is of an unusually difficult character. Nearly all matters connected with the general office building have been settled, including the re-arrangement of the ticket office; an exception is the lighting fixtures, and this will shortly be under consideration.

In the spring the old station will be removed and broad sidewalks enclosing the plaza and road from St. Paul Street to the Henderson Street entrance, together with lamp standards, started on. The object is to complete portions of the station to enable the railway companies and the public to use them in June. Mr. H. E. Prindle, of Montreal, is the architect.



General view of construction work on Quebec Union Station.

Third Canadian and International Good Roads Congress, Montreal, March 6-11.

B. Michaud, President

Geo. A. McNamee, Secretary

Evidence of the keen interest being taken in the Third Canadian and International Good Roads Congress, which is to be held at Sohmer Park from March 6th to March 11th inclusive, is shown by the number of inquiries received daily by Secretary G. A. McNamee.

The congress will have eight business sessions, not including the official opening and at each of these certain aspects of the road question will be discussed by experts in that line. It is the opinion of these well-known men that the highway authorities wish to hear and profit by. The aim of the congress is not to be the means of advocating the construction of any one kind of road, but to disseminate information as to the value of good roads to all industries, and the best methods of constructing and maintaining them. There will be papers on the construction of roads, methods, maintenance, bridges, machinery, materials, how to successfully meet difficulties of various kinds, etc. The majority of the speakers will be practical men, who have had to solve problems either of construction or maintenance.

The Lieut.-Governor of Quebec has promised to open the Congress, and invitations have been forwarded to many prominent men associated with the good roads movement. The following are some of the speakers and their subjects: Messrs. Gabriel Henry, chief engineer, Province of Quebec, "Gravel and Stone Roads"; E. Farfard, chief of equipment department, Province of Quebec, "Handling and Care of Machinery"; Alex. Fraser, engineer, roads department, Province of Quebec, "Highway Culverts"; J. W. Levesque, M. L. A., "Road Laws"; A. F. Macallum, city engineer, Hamilton, Ont., "Creosoted Wood Block Pavements"; J. Duchastel, engineer, City of Outremont, P. Q., "Brick Highways and Streets"; W. Huber, engineer, Ontario Highways Department, "Maintenance Systems"; W. H. Connell, chief of the bureau of highways, Philadelphia, "Maintenance Materials and Methods"; Frank Smith, consulting engineer, New York, "Bituminous Macadam, hot mix, using asphaltic binder"; Prof. A. H. Blanchard, Columbia University, N. Y., "Bituminous Macadam, hot mix and penetration methods using tar binder"; Major W. W. Crosby, Baltimore, "Drainage and Foundations"; Elmer Thomson, Auto Club of America, "Motor Traffic, its trend and effect"; Col. W. A. Sawyer, chairman of the Massachusetts Highways Commission, "Different Types of Development used under various traffic conditions." The Hon. T. H. Johnson, Minister of Public Works, Manitoba, will deliver an address; Mr. P. C. Emmett, secretary of the Manitoba Motor League, "The Legislative Aspect of Road Construction"; Mr. A. W. Dean, chief engineer of the Massachusetts Highway Commission; Mr. L. E. Allen, consulting engineer, Belleville; Mr. Percy H. Wilson, consulting engineer, Philadelphia; and Mr. A. G. Batchelder of the American Automobile Association.

General Types of Improved Roads—Methods of Construction and Maintenance

By George Hogarth, Assoc. Mem. C. S. C. E.*

THE program of road work to be undertaken during the coming summer will shortly be given consideration by the different councils in charge of municipal expenditure, and a short discussion of the various types of roads which are customarily built appears timely.

There are many details to be considered before adopting any particular class of road in a certain locality, and the more prominent of these are the estimated cost of the road per mile, the local material available for construction purposes, the road-making machinery or equipment possessed by the council or the use of which can be obtained if a contract is let, and the necessary local labor to accomplish the result.

A road used only by a small number of residents does not warrant great expense, and the simpler construction methods are usually employed. Where a highway serves a larger population, a heavier traffic is to be anticipated, and a type of road structure capable of giving satisfaction under such loading is necessary. A suburban road leading away from a town or city may be subjected to a large traffic composed of all the various sorts of vehicles usually met with, and such traffic calls for stout road construction capable of withstanding all the influences tending to destroy it.

Experience with the development of the traffic on main roads between cities and towns has demonstrated that the most substantial pavement is required in order that the road may be easily travelled at all seasons of the year. It is quite evident that roads must be constructed to carry the traffic which naturally reaches them, and to build a light surface on a highway subjected to a heavy traffic is hardly to be considered as economy. In many cases it is not difficult to decide on the proper kind of road to build, but the selection of a road surface to be placed on the more important thoroughfares requires earnest consideration, and it is suggested that where there is doubt as between a light and a heavy type of construction, the stronger be adopted, since traffic is expected to increase on properly built highways.

The earth road is probably to-day the one type of construction with which everybody is well acquainted, and when such a road is given any reasonable attention it gives fair satisfaction with light traffic. Such a road is constructed at a low cost, and during the dry months of the year it can be put to good use. No other type of road is so seriously affected by bad drainage, and great attention should be given to the side ditches and tap drains, to see that all water flows rapidly away from the road allowance. Water lying in the side ditches is an indication that the foundation of the road is in a soggy condition and the entire surface will soon be cut up and made into a mire. To prevent such a condition developing, proper attention should from time to time be given to the various parts of the road. Ditches should be cleaned out and rendered effective, and the split-log drag frequently employed to round up and surface off the crown of the road. This maintenance of an earth road is of great importance and every encouragement should be given to those endeavoring to carry out improvement along such lines. The results of such labor amply repay those in charge, and the more efficient road surface presented is much appreciated by the taxpayer.

* Chief Engineer Ontario Dept. of Public Highways.

In some localities sand roads are of frequent occurrence, and two methods of producing a good road surface might be considered. The first would be to endeavor to keep the road low and close to the water level of the surrounding country. Should the damp condition be maintained all summer a desirable road is produced. Should a more permanent type of surface be desired, the sand may be mixed with clay and the crown shaped up. Thorough attention should then be given to the drainage of side ditches, and by keeping the road dry and shaping it up at proper times a satisfactory result will be obtained.

Clay roads demand proper drainage from the first day they are constructed, and their improvement can be furthered by the use of an application of coarse sharp sand and dragging with the split-log drag. Good judgment and thorough working is necessary in applying the sand; surplus of either sand or clay being undesirable. Where heavy frost is experienced during winter seasons a clay road may become very soft in the spring of the year. A partial remedy for such a condition is a well crowned surface and an adequate depth and efficiency of drains and side ditches. The construction of a sand-clay road is not completed when the first effort is expended and finished. Such a kind of road is the only one obtainable in many localities and perseverance in reconstructing and maintaining it is essential to final success. With intelligent work applied to rounding up the crown and providing outlet for all water to run away from the road, great improvement will soon be shown.

Value of Gravel Roads

The application of gravel to an existing road marks a long step in advance in highway improvement. Gravel is cheap in many sections of the country, and the character of the surface which it produces is second only to the more expensive stone roads. A gravel road is easily constructed, readily repaired, and when well built is capable of carrying fairly heavy traffic. There are many methods of constructing such a road, and the almost universal and undoubtedly the cheapest appears to be to dump the gravel in a ridge in the centre of the road and let the traffic beat it down and consolidate it. Many people prefer to drive in the ditch or along the fences of such a road, and in many cases probably considerable damage is done to the shoulders and ditches before all traffic will naturally again keep to the centre. A better method to follow is to round up the shoulders of the road and spread and compact the gravel when placed. This practice may cost a little more, but the results will usually warrant the slightly larger outlay, and the people will appreciate the convenience with which the new road can be travelled. Careful maintenance of a gravel road is real economy, since a better surface is continuously secured and more wear is obtained from the one coating of gravel. Drainage also requires attention to prevent soft spots appearing in the road, and a small amount of money intelligently spent along these lines will be amply repaid in greater service.

To-day the stone or macadam road, composed of a layer of varying sized stones with a top binder of screenings or gravel, is receiving more consideration than ever before. The earth and gravel roads being weak in supporting power have crushed down under heavy traffic and necessitated the use of a stronger and more durable foundation. In the construction of these roads it is customary to use the local rock nearest to the site of the work. Some localities are provided with splendid road building rock of a hard and tough nature, while in others a softer rock may be all that is available. The character of the material composing the road is very important and if a hard, tough rock, possessing good binding qualities be used, it is natural to expect a very superior surface; while with a softer rock a grading down in the value of the roadway is expected. In other lines of business a lowering in the price of a commodity has resulted in an increased volume of trade, and with a steadily increasing demand for the better classes of road building material, a reduction of unit price would appear to be the best advertisement the quarries could have.

Treating Macadam Roads

Where a stone or macadam road has become dusty and worn, one method of repair is to clean it off, and during warm dry weather apply a coat of tar or asphaltic oil to the surface; this has the effect of eliminating the dust and furnishes a binder which for some time will absorb the particles of dust worn from the stone in the road. Should the road be subjected to very heavy traffic, the wear may be considerable and a smooth surface may be a necessity, in which case a thin layer of new stone may be applied to the road and the tar or asphaltic oil poured on and compacted, thus creating a smooth bituminous surface which gives a good wearing road. The application of the bitumen and the new layer of stone may be made by mixing the two in a mixer and then applying and rolling onto the road in a coat of definite thickness.

The bituminous pavements are very popular at the present time, and satisfactory results with this type of construction are being obtained.

In busy highways carrying heavy traffic the concrete road furnishes at the present time a stout foundation and a good surface possessing many points of interest. Concrete is not a new material of construction, and many stretches of splendid roads of this type are in use. The accepted method of construction to-day is to build a concrete slab probably six inches thick at the sides and eight inches thick at the centre, and having a width of a double roadway, which is now usually eighteen feet. This slab may be of reinforced or plain concrete, depending on local conditions, and the steepest grade to which it is advisable to construct it is four per cent. The completed roadway furnishes a surface which is very even and pleasant to ride over, and is to-day one of the accepted types of paving applied to heavy traffic highways.

In conclusion there are to-day various types of roads such as earth, sand, clay, gravel, stone, bituminous and concrete, each of which requires adequate drainage, proper maintenance and intelligent repairs in a more or less degree. Drainage is a necessity in every case, except in one class of sand road, and with good side ditches almost any type of road furnishes a relatively satisfactory surface. The maintenance and repair of roads is now being encouraged in many ways since such work is essential to preserve and keep the surface in a satisfactory condition, and when such a system is in proper operation all roads which are given attention should be passable at all seasons of the year.

North Shore Marine Drive, West Vancouver

By W. H. Larson*

THE North Shore Marine Drive is the initial section of that long-projected extension of the Pacific Highway which will extend eventually from Vancouver to Alaska. The municipality of the district of West Vancouver was the first to take active steps to carry their ambitions to a fruition. Aided by the active co-operation, advice and financial assistance of the Premier of the Province, Sir Richard McBride, a good roads enthusiast, the municipality has recently completed a magnificent section of permanent pavement.

On the 11th of August Sir Richard had the pleasure of formally opening this first section of the road. In his address he expressed surprise at the easy grades, the heavy rock cuts, the permanent and beautiful concrete bridges, and finally said that it was his conviction that the North Shore Marine Drive had no superior, in quality of construction and beauty of scenery.

The Drive has been in the development stage for the last four years. In 1913 the Marine Drive by-law was passed by the ratepayers of West Vancouver to provide for the permanent improvement. The war caused a cessation of all plans for some time, but after the municipality had failed in their attempts to finance the work the Cotton Company, Limited, of Vancouver, took up the work and accepted the bond issue in payment. The contract consisted of clearing and grading from Station 0 to Station 67, a reinforced concrete bridge, and four miles of asphaltic concrete pavement. It was the original intention of the municipality to put in a macadam roadway, but the contractors were successful in showing the false economy of constructing a macadam road, with a life of possibly three years, to be paid for with forty-year bonds; the plans and specifications submitted by the contractor for the pavement proper called for permanent construction—that is, one and one-half inches wearing surface of asphaltic concrete on a four-inch hydraulic concrete base.

Concrete Base.—After a careful study a concrete base was selected as more economical than a macadam or a bituminous one. The type adopted consisted of a four-inch base with the edges turned up to form a monolithic curb. The mix was one cubic foot of cement to nine cubic feet of sand and gravel. The concrete was mixed in an eighteen-cubic-foot Foote Mixer and hauled in Briggs concrete carts to extreme hauls of fifteen hundred feet. The concrete crew was organized as follows: four men at the mixer, seven men spreading, four single-horse carts hauling, two men on water supply pipe-lines, two men setting screens, and six men grading. This crew averaged one thousand square yards a day, and had a maximum of fifteen hundred. As the mix was low in cement and the base thin, extraordinary care was taken in workmanship and in the mechanical grading of the aggregate. Daily

* Engineer, M. D. Cotton Co., Ltd.

tests were made, a short summary of which are tabulated:—

Test of Cement—Vancouver Brand

	High	Low	Average
Specific gravity	3.168	3.122	3.152
Initial set	2hr. 45m.	4hr. 5m.	3hr. 30m.
Final set	5hr. 40m.	6hr. 55m.	6hr. 0m.
Per cent. passing No. 100 sieve	99.1	98.5	98.9
Per cent. passing No. 200 sieve	89.0	97.2	87.7
Boiling test	O.K.	O.K.	O.K.
Tensile strength neat 24 hrs.	482 lbs.	362 lbs.	419 lbs.
Tensile strength neat 7 days	758 lbs.	555 lbs.	678 lbs.
Tensile strength neat 28 days	813 lbs.	677 lbs.	739 lbs.
Tensile strength, 1 cement, 3 sand, 7 days	398 lbs.	312 lbs.	358 lbs.
Tensile strength, 1 cement, 3 sand, 28 days	483 lbs.	377 lbs.	420 lbs.
Compression, 1 cement, 3 pump sand, 7 days			1591 lbs.
Compression, 1 cement, 3 job sand, 7 days			2590 lbs.
Compression, 1 cement, 3 Ottawa test sand			2576 lbs.
Compression, 1 cement, 9 cu. ft. sand and gravel, 7 days.	2107 lbs.	974 lbs.	1384 lbs.
28 days.	2794 lbs.	1106 lbs.	1904 lbs.

Mechanical grading of materials: Sand.

Sieve	Per Cent. Passed Pumped Sea Sand	Per Cent. Passed Job Sand
½	100	...
¼	99	100
No. 10	97.8	72.8
No. 20	90.8	50.4
No. 30	48.2	28.6
No. 40	21.2	19.0
No. 50	4.1	9.0
No. 80	0.6	3.6
No. 100	0.2	1.8
No. 200	0.1	0.4

Sieve	Per Cent. Passed Job Gravel
2½-inch	100
2-inch	80.1
1½-inch	42.7
1-inch	18.2
¾-inch	2.5
½-inch	0.0
¼-inch	0.0

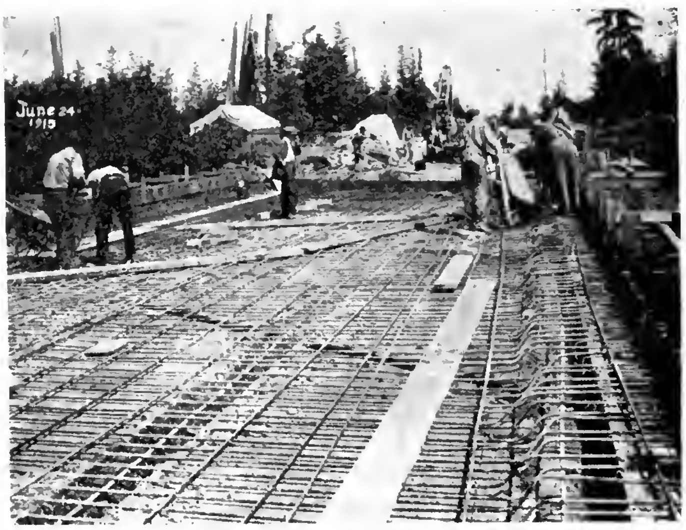
Two kinds of sand were at first used, the mix being one part of pumped sea sand, two parts of washed bank sand, and six parts of gravel. As a result of the above tests the pumped sand was discarded.

Asphaltic concrete wearing surface was mixed in a new type of portable plant built on the concrete mixer type, with a surrounding heat jacket with fire grates beneath. The plants are most economically worked in pairs, one gang handling both. The gang is organized as follows: 1 foreman, 1 steam engineer, 1 torch tender, 1 platform man, 1 dump man and fire tender, 1 wheelbarrow man for coarse fines, 1 wheelbarrow man for graded fines, 1 wheelbarrow man for sand, 1 asphalt kettle tender, 1 asphalt carrier, 1 water and chore team.

The street gang is organized as follows: 1 foreman, 1 roller man, 1 raker, 2 shovellers, 1 flush coat and squeegee man, 1 concrete sweeper, 1 asphalt tamper, 1 tender for asphalt kettles and fire wagons.

The sequence of operations is as follows: wheelbarrow men load the mixer with four cubic feet of coarse fines, four cubic feet of graded fines, and two cubic feet of asphalt sand. The torch man now inserts the kerosene torch into the mixer and the mineral aggregate is heated by the combined action of the torch and the heat from the fire beneath the drum. In about eight minutes the aggregate is thoroughly dried and heated to a temperature of about 250 to 275 degs. Fahr. The torch is now removed and the platform man puts 90 lbs. of asphaltic cement at a temperature of about 275 to 300 degs. Fahr. The asphaltic cement is passed to him in buckets by the kettle tender. The batch is now heated without the use of the torch, so that the bitumen is not exposed to the direct action of a flame at any time. The mixing action of the machine is that of kneading or folding. This action is superior to that of the pug-mill or paddle mixer for the mixing of asphaltic concrete, as the paddles have a tendency to separate the larger rock from the sand. This same point is noticeable in over-raked asphalt on the street; the rakes bring the larger particles to the surface. The dump man now dumps the batch into the Briggs concrete cart and the recharging begins. The cart is now moved over to the second mixer, which has followed up the same sequence of operations, but with all operations two minutes later. The cart is filled with the second batch and hauled to the spreading gang. The economic limit of haul with the single-horse carts we found to be

Ten ton roller on surface work, Marine Highway, B. C.



Reinforcement for river bridge, Marine Highway, B. C.

TABLE I—GRADING OF MATERIALS USED IN ASPHALTIC CONCRETE TOP

Sieve:—	No. 200	No. 100	No. 80	No. 50	No. 40	No. 30	No. 20	No. 10	¼-in.	½-in.
Asphalt sand	7.6	9.4	12.2	16.6	21.6	10.0	7.8	2.6	2.6	4.6
Coarse Fines	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	22.4	76.4
Graded Fines	9.2	6.2	3.6	6.2	5.6	5.4	13.0	16.8	28.6	5.4
Ideal										
Per cent. passing each screen..	6	10	14	22	26	28	34	42	65	100
Per cent. retained on next smaller sized screen	6	4	4	8	4	2	6	8	23	35
First Trial										
20 per cent. asphalt sand	1.52	1.88	2.44	3.32	5.32	2.00	1.56	0.52	0.52	0.92
45 per cent. graded fines	4.14	2.79	1.62	2.79	2.52	2.43	5.85	7.56	12.87	2.43
35 per cent. coarse fines	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.21	7.84	26.74
Per cent. retained on next smaller sized screen	5.66	4.67	4.06	6.11	7.84	4.43	7.62	8.29	21.23	30.09
Per cent. passing each screen ..	5.66	10.33	14.39	20.50	28.34	32.77	40.39	48.68	69.91	100.00
Second Trial										
20 per cent. asphalt sand	1.52	1.88	2.44	3.32	5.32	2.00	1.56	0.52	0.52	0.92
40 per cent. graded fines	3.68	2.48	1.44	2.18	2.24	2.16	5.20	6.72	11.41	2.16
40 per cent. coarse fines	0.00	0.00	0.90	0.00	0.00	0.00	0.24	0.24	8.96	30.56
Per cent. retained on next smaller sized screen	5.20	4.36	3.88	5.80	7.56	4.16	7.00	7.48	20.92	33.64
Per cent. passing each screen ...	5.20	9.56	13.44	19.24	26.80	30.96	37.96	45.44	66.36	100.00
Average grading of 56 samples on job										
Per cent. passing each screen ..	5.97	9.93	12.55	17.68	23.48	28.93	38.47	48.34	72.69	100.00
Per cent. retained on next smaller sized screen	5.97	3.96	2.62	5.13	5.80	5.45	9.54	9.87	24.35	27.31

about two thousand feet; at this distance six carts are required; at a thousand-foot haul two carts will keep the plants working to full capacity. The material is now spread with shovels and raked to a true surface and thoroughly consolidated by means of a ten-ton roller. While the surface is still warm a seal cast of asphaltic cement is spread and then covered with a light layer of one-quarter-inch screenings which are thoroughly rolled in. The elements of prime cost of one thousand square yards of asphaltic wearing surface one and one-half inches thick is as follows:

At the plant: labor, 229 hours; asphalt, 21,172 lbs.; asphalt sand, 19.5 cu. yds.; rock fines, 58.5 cu. yds.; coal, 3.4 tons; kerosene, 48 gallons; water team, 11 hours.

Hauling hot stuff: single horse 32 hours.

Street gang: spreading labor, 139 hours; sweeping concrete, 31 hours; roller coal, 6.6 sacks; asphalt for flush coat, 3.9 bbls.; rock fines for squeegee, 2.5 cu. yds.

The method of obtaining the best grading of the mineral aggregate for use in this type of asphalt plant is somewhat different to that in use in larger and more expensive plants. The scheme used is that of blending two or more materials in varied proportions to obtain the required amount on each screen. The procedure is illustrated in Table I.

First, the various materials available are screened and their respective gradings placed in the table.

The ideal and the various materials are now studied with a view of selecting unit cubic feet or half cubic feet to a total number of ten, which is the box or batch size in use; which when combined will conform to the predetermined standard. The calculations are simple, and a few trials will at once show up the inherent possibilities of the materials. The success of this method depends upon the materials running uniform from day to day, and also upon the wheelbarrow men getting the right amount in each load. As to the first objection, the materials used were very good, and daily tests showed practically no variation. The second objection is more serious, and called for careful coaching of the laborer and frequent admonitions from the foreman. However, an error of one-half cubic foot is about the limit, and a study of the tabulation will show that this would cause no serious injury to the mix.

Daily samples were taken and analyses were made by competent chemists, who reported to the plant foreman. The plant foreman varied his mix as indicated by the daily tests. Tests as follows:—

Analysis of Asphaltic Cement

	High	Low	Average
Penetration 77 F. 5s. No. 2N. 100G	64	43	57
	%	%	%
Loss at 325 F. 20G for 7 hours ...	1.21	0.55	0.87
Soluble in carbon bisulphide (25C 18 hours)	99.71	99.51	99.63
Soluble in carbon tetrochloride (25C 18 hours)	99.57	99.40	99.46
Soluble in 86 Naptha (25C 18 hrs.)	78.12	75.36	76.80
Fixed carbon	10.80	9.15	10.17
Per cent. of asphalt in asphaltic concrete	10.20	7.20	8.03

Reinforced Concrete Bridge

The east branch of the Capilano River was spanned by two thirty-foot girder skew spans, with filled abutments and retaining walls. The girder type was selected in preference to an arch, as the character of the stream and the footings rendered the cost of the arch abutments prohibitive in price, and the necessary rise of the arch could not be obtained without unduly raising the grade of the roadway. The design consisted of main girders spaced six feet centre, connected by a transverse stiffening girder and a con-

Reinforced Concrete Bridge, Marine Highway, B. C.

crete deck slab. The spans were designed to carry a twenty-ton road roller, which gives an equivalent loading of 1,300 lbs. dead load and 1,100 lbs. live load per lineal foot or maximum moment of 255,000 foot-pounds. The unit costs of construction are as follows:—

Excavation for footings, per cubic yard		$0.88
Fill in approaches, per cubic yard		0.39
Reinforced Concrete:		
Screening gravel and teaming, per cu. yd. of concrete		$0.75
Labor, mixing and placing	do	1.81
Reinforcing steel	do	2.30
Reinforcing steel, teaming	do	0.10
Reinforcing steel, placing	do	0.62
Forms erection labor	do	1.44
Forms stripping labor	do	0.48
Forms, lumber	do	1.52
Cement	do	2.86
Total	do	11.86
Concrete railing, per lineal foot		1.58

Maintaining the Public Highways

By R. H. Fair*

IN Canada at the present time we have one job to attend to. Those who are fit should don the khaki, and those who are not fit should assist financially and in every other way possible to bring the great world struggle to a successful conclusion. In doing so, it is not necessary to lose interest or sight of the great problems which present themselves in a young and growing country like Canada.

One of the problems I will mention in our home province and which, before the war broke out, was of the greatest moment—it is the question of building and maintaining the highways of Ontario. This will have to be grappled with because it affects either directly or indirectly every person in the province.

Great movements, to be successful, must be backed up by the majority of the people. Many great reforms have met disaster or have been retarded by trying to force them in advance of the sentiments of the people. Consider the great revolution which is to take place in changing the building and care of highways from the old form of statute labor—favored by some because of getting rid of the annual road tax, and, by others, because of the pride they have taken in their beats, although the latter are sadly in the minority—to a system of government and county control. When you think of it, the road that ten years ago was considered satisfactory is not considered at all an economical kind of road to construct for the mixed traffic of today. This means larger expenditures, which, outside of government or other assistance, must be met by a direct taxation, which should make it as light as possible on the rural population, so that the movement of people from urban to rural points, or vice versa, should not be hindered.

Education must go in advance of the Good Roads movement. The ratepayers should know, if possible, what type of road would be required in their municipality, what it would cost per mile and the share that each would be called upon to pay.

There have been many changes brought about by legislation and Good Roads Acts since such laws were first placed on the Statute books. For instance, this year, the percentage for construction has been raised from 33 to 40 per cent. and for the first time 20 per cent of maintenance requirements is to be paid by the government. However, I think that when things become normal again, there will be room for further improvement in the percentage of construction. I would suggest that the fees from auto vehicles be placed in a special fund for maintenance only and used for no other purpose. Then this percentage could be raised from year to year, as the fund would permit.

The argument is often raised by the farmers: "What's the use of building a first class road for the autos to destroy?" This could be offset if it was proved that the autos were paying their fair share for the use of the road.

There are a number of counties that are past the initial stages in the Good Roads movement. It largely depends upon their success or failure whether other counties, that have not taken up the work, do so or not. Before they go into the system of Good Roads, they are likely to make enquiries from counties that have tried it.

To sum up, the success or failure depends largely on the county roads engineer or superintendent, who is in daily touch with the ratepayers of the county. He should seize every opportunity to demonstrate the advantages of good roads and to publish in pamphlet form every detail for the expenditure of each piece of work, so that if anyone chooses he may know how the money has been spent on the piece of road opposite his own property. If you can convince them that there is no graft, that the money is being judiciously spent and that they are not being taxed unjustly, we shall soon have little or no opposition.

*Road Superintendent, Frontenac County

The Boston Elevated Railway Company, owners of a brick office building occupied by the Bay State Street Railway Company as headquarters of its electric freight business, recently moved the building about 150 feet to a new location, on Atlantic Avenue, Boston. During the process of moving, heating for the offices, which continued to be occupied without interruption, was provided by means of about 50 electric radiators, which were connected to the Elevated Company's circuits by means of temporary wiring. As the moving took place during mid-winter, the need of artificial heat presented a problem which could only be successfully met by the electric heating installation.

Quebec Province Added Three Hundred Miles Macadam Roads in 1915

THE progress of the Good Roads movement in the province of Quebec is well evidenced by the fact that during 1915 there was constructed in that province under the direction and with the aid of the local Government 295.6 miles of macadam roads and 140.7 miles of gravel roads, in addition to a very large amount of maintenance work, particularly on earth roads. The Department is well organized. The work of the instructors, contractors, and inspectors is clearly outlined and vigorously prosecuted.

A report just to hand of the Minister of Roadways, Mr. B. Michaud, indicates that the sentiment in favor of good roads has undergone a marked change throughout the province within the last few years. Instead of it being necessary for the Government to carry on a campaign of education, the people have actually taken the matter in their own hands, and are urging the Government to the limit to spend all the funds that are available on the amelioration of the roads of the province. The work is being carried out, as already noted, in a most scientific and efficient manner. A testing laboratory, referred to below, operates continually in the interests of Good Roads problems.

Gravel Roads

The Minister of Roadways expresses his opinion that while he is willing to admit the necessity of the gradual substitution of hard surface roadways, he believes that the gravel road is capable of rendering very distinct service. When it is properly made it affords as favorable a roadway for automobile traffic as for ordinary vehicular traffic, and it may well be employed in place of macadam, especially on account of its relative low cost—one-third to a quarter that of macadam. Regarding the use of gravel there are, however, two principal points to consider—the distance it has to be transported, and the quality of the gravel. Up to two miles the carrying of gravel is economical, especially if it is of a superior quality. Certain gravels have a binding quality, requiring neither rolling nor watering, and so their use saves a very considerable expenditure. Much depends on the quality of the gravel and on its cleanliness. A gravel containing more than twenty per cent. of earth matter should be rejected, or the earth separated out.

Macadam Roadways

Regarding macadam roadways, the province is divided into districts for purposes of construction and inspection. The supervision of this work is important and costly, but is one of the features that the Roadways Department considers most necessary. They work towards greater efficiency in this direction from day to day, and endeavor to keep their inspectors at maximum efficiency. This system of inspection is indicated in the following instructions, which are given out to the different inspectors:

Inspectors' Instructions

Teach the instructors the best method of making the macadam, draining, building the culverts, proper manner of disposing of the men over the work, and the necessary care of the machines. The inspector must assure himself that the workmanship conforms with the specifications furnished the instructor.

Re-set the machines in better position if necessary. Make little adjustments, which ought to be made without having recourse to repairers; have the mechanics make these little repairs.

Inspect carefully the works at least two days to each plant. If it seems wise to remain longer, advise the Department by telephone or send telegram to obtain authority.

Work seriously towards reforming the organization, so as to carry on the work economically; it is one of your most important duties. Dismiss immediately the useless or incompetent workman.

See that each course of stone is separately rolled.

See to it that the stone-dust is distributed over the road with a shovel, and be sure that this dust is not used to fill in depressions or left in heaps. See to it that the roller does not roll more than sixty feet in length at one time.

It is the duty of the instructor-inspector to study the instructions and duties of the instructor, of the man who operates the roller, and the man who operates the engine, that he may be well advised of the various operations and the better able to make his report. Every week it is his duty to fill in the blank report furnished and send it to the Department every Saturday evening.

In each municipality where an inspection is made inspectors are expected to get in touch with the superintendent or overseer of the work appointed by that municipality, as well as the Government instructor, where there is one.

In municipalities which have their own equipment, if the instructors or the superintendents are incompetent or fail to do their duty, advise the Department immediately by telegram and give explanations at length by letter. It is the duty of inspectors. The greatest care is enjoined on the inspectors as to the method of making their inspections, and very complete written instructions are provided.

Montreal-Quebec Route, Macadam made in 1915.

Provincial Roads

Montreal-Quebec Section.—This great highway, already the admiration of tourists, and which also has a very great value for the agricultural interests which it serves, is almost completed. The eastern division has a length of 48.37 miles. On the centre division 26.4 miles are finished and 6.63 miles well under way. On the west division 27.94 miles are completed, and the foundations laid on the remaining 20.5 miles.

Levis-Jackson Section. This is a stretch of roadway 90.15 miles long between Levis and the frontier. Unusual difficulties have been met with over this piece of roadway, but a total of 66.28 miles is complete.

Sherbrooke-Derby Line.—This is about thirty-two miles in length, from Sherbrooke to the frontier. 6.6

miles have been macadamized, 23.24 miles have been gravelled, and a short distance in the village of Rock Island has been gravelled and covered with tarvia. This is a most attractive road, following the shore of the beautiful Lake Massawippi, and constitutes, both for the agriculturists of this section and for the tourists from the United States, an improvement already full of advantages and promise. Many difficulties were met with on this work, but the contractors worked with a will, so that in one single season another artery of the Good Roads system of the province has been completed.

Chambly Road.—This is about twenty miles long, and is completed. It was constructed by the municipalities interested, and opens direct communication between Montreal and the frontier by way of St. Jean.

Some of the fine roadways of the province of Quebec are shown herewith.

The Testing Laboratory

The following interesting report by Gabriel Henry, chief engineer of the Department of Roads for the province of Quebec, indicates the care taken by this Department in the efficiency of the work carried on. It is headed "A Report concerning the examination, tests, and analyses of materials made at the laboratory of the Minister of Roadways of the Province of Quebec."

Materials generally sent to this laboratory consist of stones, gravels, sands, cements, and concrete pipe, which are examined from the viewpoint of their acceptability for roadway construction or for concrete work.

Stone.—Samples of stone are sent either by the instructors and roadways inspectors, by the municipalities, or by the owners of quarries who may propose selling stone to the municipalities. The choice of a sample of stone is an operation that requires considerable precautions. The quality of stones in one quarry may vary greatly from the stones in another quite close. Even in the same quarry one often finds stones of quite different qualities. In any quarry stones on

Banlieue to Three Rivers—Concrete laid in 1915.

the surface are not representative in general of those found at greater depth. In the same quarry we find different layers at different levels with stones of different natures.

Of course, the laboratory can only pronounce on the samples which are sent to it, and it frequently happens that these do not represent accurately the stones which it is intended shall be used. For example, a municipality, or an individual, sends a sample of stone taken from the surface of the quarry or from a layer of inferior quality. The report is unfavorable. Some time afterwards the same individual may send another sample taken from the same quarry but more carefully chosen, and the report may be favorable. It is neces-

Good Roads in Compton, P.Q., Macadam built in 1915, Road before, during and after construction.

sary that the attention of instructors, inspectors, municipalities, and quarry owners should be drawn to this matter.

Again, a stone of fair quality may easily be accepted in one case and refused in another. For example, one might accept a stone which is not very hard, though quite sound, for a road where the traffic is light or where automobiles do not pass, if the municipality is not able to procure better quality or may not be in a position to pay the necessary price; while for a road with more traffic it would be more economical for the municipality to procure a better quality. In this latter case the sample submitted would be refused. Sandstone may be accepted when the substructure of the road is very solid, but refused in other cases because it would be absolutely impossible to bind, employing a calcium binding. It will thus be seen that a multitude of considerations regulate the choice and acceptance of stone. In the laboratory the stones are examined from the viewpoint of their geological production, their nature, their hardness, their resistance to crushing and wear, their friability, and the facility with which they will bind themselves together.

Gravels and Sands

For the selection of samples of gravel the same remarks hold good as in the case of stone. Gravels and sands are examined either from the viewpoint of their employment in road construction or their use in concrete work. In the first case the examination consists in making note of the nature of the flints and grains which compose them, of their hardness, their size, and of the nature and proportion of the sand and earth matter present. This examination permits of issuing directions on the method of employing these gravels and making a choice between several gravels taken from different beds.

When the sands or gravels are to be employed in concrete construction work, one examines their nature, then establishes their granulometric form by means of sifting. The sifting determines the relative proportions of grains of different size. The granulometric degree of a gravel or sand is extremely important. A gravel or sand of which the relative proportions of different sizes are just right gives a cement more resisting than another in which the proportions are wrong. The granulometric study of sands and gravels before their employment in concrete means economizing cement in large measure, as well as obtaining a higher resistance.

The gravels to be used in the making of concrete are also examined for clay, organic matter, and earth matter which may be contained. Organic matters, even in very small quantities, prevent the hardening of the concrete. Plaques and briquettes of cement are made with the gravels and sands, and are tested with a tension machine, which indicates their resistance to compression in pounds per square inch. Certain tests are made after allowing the plaques and briquettes to stand in water for varying periods. If the resistance, either to compression or separation, is too low, these sands and gravels ought to be rejected.

Cements

Samples examined cover generally cements employed by contractors or municipalities in the construction of bridges and culverts or in the fabrication of various concrete pipe. The cement tests are made according to the method recommended by the Canadian Society of Civil Engineers, and show the density, the fineness, purity, the hardness in the early and in final stages, the constancy of volume, and the resistance of briquettes and plaqùes to compression and separation. Just as with sand, these two last tests are made with samples seven days and twenty-eight days old. These samples are made with tested cement and with sand known as the "Standard Ottawa Sand." This is a white sand which comes from Ottawa, Ill., and is now employed in such tests by all laboratories.

Concrete Tiles

Manufacturers of concrete tiles for the most part make their own pressure tests. The resistance to compression ought to be that of a good concrete—that is to say, at least 200 pounds per square inch at the end of one month. The concrete in these pipes is also examined as to its constitution.

A register of all the tests is kept in the laboratory. The samples submitted are also preserved.

The Good Roads Problem in Manitoba

By Archibald McGillivray*

DESPITE the fact that the year 1915 may be considered an off year in the expenditure of large sums of money in public enterprises, with the exception perhaps of those directly associated with a vigorous prosecution of the war, municipalities in the province were able to carry out such contracts as they were engaged in and others have contracted for fairly large expenditures.

The Municipality of Assiniboia completed its contract with the National Paving Company, of Winnipeg, for the construction of 5.42 miles of asphaltic concrete pavement on the Portage Highway. The total expenditure in connection with this contract was $163,000. This gives the above municipality 5.38 miles of continuous pavement 24 feet wide from the western limits of the city of Winnipeg and 4.00 miles of the 16 ft. pavement continuing from the end thereof, or a paved road from the city of Winnipeg to the village of Headingly, 9.38 miles distant to the west. The total cost of this mileage of road was $386,192.62, of which $85,733.50 was borne by the provincial government.

The municipality of St. Vital entered into contracts with the Guilbault Construction Company, of St. Boniface, for the construction of 0.8 miles of reinforced concrete pavement 16 feet wide, at the contract price of $14,120; and with Thos. Jackson & Sons, of the city of Winnipeg, for 5.4 miles of concrete pavement for the sum of $94,594. This work is on St. Marys Highway, leading from the city of St. Boniface to the south, along the east bank of the Red River. The first mentioned contract in the municipality was completed last year, and a start made by the Thos. Jackson & Sons on the grading of the second portion of the road, which portion it is proposed to complete early in the present year.

In the municipality of Wallace, situated in the extreme west of the province, the prosecution of its scheme to construct 194 miles of roads at the estimated cost of $301,500 was continued last year. A contract for the grading of an additional 58.0 miles to that previously under way was let to A. R. Boivin, of Winnipeg, last June, at the price of 20 cents per cubic yard, pit measurement. Contracts were also let for the construction of 9 reinforced concrete bridges and 3 reinforced concrete culverts, all of which bridges were constructed last year. It is the intention to gravel 105 miles of the roads included in the whole scheme and to bridge the total mileage with permanent structures.

The Municipal Council has just completed the sale of $40,000 worth of 40-year debentures to carry out its share of next season's programme of construction. The Provincial Government contributes fifty per cent. of the total cost of constructing gravel roads and permanent culverts and bridges, and 33 1/3 per cent. of the cost of graded roads.

The cost per mile for grading an 18-ft. roadway in this municipality averages about $800, constructing and placing pipe culverts about $110 per mile of road,

* Highway Commissioner for the Province.

and the average cost of gravelling with 525 cubic yards of gravel per mile is about $425.

Upon the completion of this scheme in hand this municipality will have what may be considered its leading market roads in splendid shape, and will have the foundation of a good system of main roads. The Municipal Council has authorization from the ratepayers to issue $150,000 worth of debentures bearing interest at 4½ per cent. per annum, $25,000 of which are for thirty years and the balance for forty years. Of this amount the proceeds $85,000 worth are as yet unexpended, and $45,000 yet unsold.

The assessed valuation of the taxable area of the municipality is $3,723,180, there being in all twelve townships in the municipality.

Four other municipalities were also engaged last year in constructing roads under the Good Roads Act, but these operated on a much smaller scale than the last mentioned municipality, although a well defined plan has been laid out in each of the municipalities. In the majority of municipalities in this province there is an averseness as yet to the issuing of long termed debentures for road construction purposes. The ratepayers appear more satisfied to proceed on the "pay as you go" plan. Whatever be the arguments in favor of following such a course, it will certainly require a number of years before the municipalities will have the systems of well constructed roads that many of them should have.

It is the aim of the Good Roads Department of the Government to induce the Municipal Councils to avail themselves of the assistance, both financial and engineering, provided in the good Roads Act, 1914, in their expenditure of this amount. The acceptance by the municipalities of this assistance and the direction of the annual expenditure made by them, if devoted along up-to-date and systematic methods, such as are laid down in the Act, would result in decided improvements in the conditions of the rural roads in this province. From the applications now being received from different parts of the province, it is obvious that the municipalities will more generally avail themselves of the assistance of the Act, and it is expected that the benefits resulting therefrom will induce many of them to undertake larger and more comprehensive schemes.

The intent of the Good Roads Act of this province is to formulate and assist municipal councils in building the main market roads in their respective municipalities, the construction of great provincial highways across the province being as yet considered of secondary importance to the establishment of local main road systems,—the extension and development of which would, of course, ultimately result in a provincial-wide system. The needs of the municipalities in providing the producer with better facilities in reaching his market are more apparent than the necessity of trans-provincial or even inter-urban communication, as there is no doubt but the improvement of market roads will assist materially in developing improved conditions between towns and villages.

The Act also provides for financial assistance to municipalities of fifty per cent. of the cost of the construction of permanent bridges and culverts. In many municipalities where such structures in considerable numbers are required, attention is being given to this phase of the road problem first. There is no doubt much wisdom in pursuing such a course, as a road cannot be considered any better than its poorest portion, and the existence of an improperly constructed bridge in a road is more to be avoided than an indifferently built roadway.

The Haldimand County Road System

By D. W. Burney*

IN this county we have 123 miles of road under our system, 25 miles of which has been graded and metalled and the balance are clay roads. This present season we expect to see them all graded for the first time. Four years ago we organized a maintenance system, dividing our 123 miles of road into forty divisions. The Superintendent, assisted by the Reeves of the different municipalities, made a selection of the best available men to act as foremen on the forty divisions. This system has given us good results.

In March we hold a conference for one day with forenoon and afternoon sessions. This conference is composed of the forty Foremen, the seventeen Councillors, the Engineer and Superintendent. The Superintendent presides and gives the opening address, we then have about six good practical lectures delivered on the different kinds of maintenance work. A limited amount of time is given after each lecture for discussion.

Each foreman is furnished with two time books, in which he keeps a record of the time of each person he employs and how employed. At the end of each month he forwards one of his time books to the Superintendent, who checks it over and then transfers it to a time sheet and certifies to its correctness. It is then forwarded to the Warden, who signs it and forwards it to the Treasurer, who issues a cheque to each person on the time sheet and forwards them to the foreman of the Division. The Superintendent in the meantime returns the time book to the foreman, who compares the cheques with his time book and then gives each person their cheque, having them receipt for same in a column in the time book for that purpose. The Superintendent keeps in his office a maintenance ledger in which is opened an account with each of the forty divisions, with headings as follows:—Grading, Leveling, Draining, Weeds, Repairs to Entrance Culverts, Road Culverts and Bridges, and Resurfacing and Repairing Metalled Roads.

As early as possible in the spring the Superintendent goes over each division with the foreman and decides what work is to be done the coming season, making an estimate of same. He submits his report to the Road Committee, who check it over, making what revisions they may think necessary, and hand it on to the whole council for adoption.

We usually spend about $6,000 on the whole system, averaging $150 to each division. This expenditure keeps our roads in good shape and our foremen take a keen interest looking after their division. After four years of experience in this system the people generally are well pleased with the results.

* County Road Superintendent, Haldimand.

Latest Developments in Concrete Roadways*

By H. S. Van Scoyoc, A. M. C. S. C. E.*

POSSIBLY no stronger evidence of the increasing interest in concrete road building could be offered than the fact that the registered attendance at the Second National Conference on Concrete Road Building, held in Chicago, February 15th, 16th, 17th and 18th, 1916, was more than fifty per cent. greater than that at the first conference, held in February, 1914. College professors, highway engineers and contractors spent four days in discussing committee reports, exchanging experiences, and outlining the most satisfactory methods for future work.

In 1914 more than 14,000,000 square yards of concrete paving was laid on streets, roads and lanes in Canada and the United States, a quantity just about equal to the total yardage laid previous to that time. In 1915 contracts were let for more than 19,000,000 square yards, but the extraordinary weather conditions interfered so seriously with construction work that the yardage completed amounts to about 15,250,000 square yards. From present indications more than 20,000,000 square yards will be laid during 1916.

Few changes have been made in the standard specifications, but there are certain tendencies that are well worth noting.

Reinforcing

There is increasing evidence of the value of reinforcing, but it must be admitted that no rational basis for determining the quantity required or the most desirable form has yet been devised. Experience seems to be the only guide.

Joints

The serious difficulty experienced in installing some of the earlier forms of metal protection plates and the discovery that improperly installed joints require practically the same amount of maintenance as unprotected joints has led to a very general use of unprotected joints. However, certain localities have found value in metal plates and, if the mechanical difficulties are overcome by the manufacturers, their use may increase.

The space between joints is being increased, especially where the paving is reinforced. The use of a poured filler has been almost entirely discontinued, except where a joint is used along the curb. A built-up filler consisting of a bituminous central portion enclosed in felt impregnated with bituminous material seems most satisfactory. The thickness is seldom greater than one-quarter of an inch.

Increasing stress is being placed on the necessity for careful testing of the cement, sand and stone. Sand and stone must be carefully inspected before going into the work and definite requirements as to grading, strength, resistance to wear, etc., must be met before the materials can be considered satisfactory.

Mixing

The unsatisfactory results from attempting to speed up the revolutions per minute have led to the setting of sixteen revolutions per minute as a maximum. Each batch should remain in the drum a full minute.

Sloppy mixtures must not be permitted. The proper quantity of water must be added to produce a concrete of rather stiff consistency.

The advance in the construction of mixers with chutes has been such that where sufficient slope is given to the chute concrete of proper consistency can be deposited in this manner. Where bucket and boom is used the overturning bucket has been found more satisfactory than the bottom-dump bucket.

Handling and Transporting Materials

Important savings can be effected, especially on the larger contracts, by the installation of labor saving devices. The value of any particular method depends upon the conditions to be met. Unloading machinery of the conveyor type and cranes or derricks with buckets are satisfactory. Tractors with trailers, motor trucks and industrial railways have all shown striking savings under advantageous circumstances.

Maintenance

The chief advance in this respect has been the use in some sections of a repair outfit mounted on a light motor truck. In some instances costs have been reduced one-third in this way.

Width of Paving

The desirable width of concrete for single traffic roads is ten feet, for double traffic roads eighteen feet and for triple traffic roads twenty-four feet. While the use of narrower widths may be justifiable in special cases, the great increase in the number of vehicles and the speed of the motor traffic that follow the completion of a good road usually lead to regret almost as quickly as the road is opened to traffic.

* Chief Engineer, the Toronto and Hamilton Highway.

Good Roads in and around Ft. William

By R. R. Wright*

FORT WILLIAM besides being a distributing centre for Canadian West grain is the centre of a well populated farming district.

The Ontario Government has provided a good system of roadways to serve the farming district and the international highway to Duluth is well on the way to completion.

The district roads are for the great part graded earth roads, the main feeders being mostly gravel and some few broken stone.

In the City of Fort William there are about 71 miles of improved streets. The following is a list showing the mileage of road improvements to date in Fort William:—

	Miles
Asphalt Block Paving	1.672
Street Asphalt Paving	.595
Bitulithic Paving	.240

* City Engineer, Fort William, Ont.

Asphaltic Concrete Paving	2.159
Tarvia X Macadam	.073
Rocmac Macadam	1.485
Macadam (earthbound)	5.265
Gravel Streets	25.51
Graded Streets	54 10

The high cost of pavements has been the cause of a curtailed street improvement programme in the city up to the beginning of the war, and in 1914 it was decided to construct macadam roads at an average cost of $1.20 per square yard or approximately 57 per cent. of the average cost of asphaltic concrete paving at $2.10 per square yard. The results obtained are highly satisfactory and compare very favorably with a paved street.

The construction was carried out as follows: The surface was shaped and rolled with a 10 ton roller. A course of blue sandstone and slate consolidated to 8 in. in thickness with a 15 ton roller furnished the base. On this was spread a layer of 4½ inches of 2 inch gauge broken hard-trap rock, and 2 inches of binding (earth); the whole was consolidated by a 10 ton roller and well slushed with water to a finished thickness of 3½ inches. After the surface had become smooth, even, and to grade and camber a hose was played on and the surface cleaned off free from dirt. The road was then left to dry out and no traffic allowed on it. As soon as it was dry Tarvia B was spread by hand brooms and ⅜ in. hard-trap screenings (sufficient to conceal the tar) thrown evenly over the top. The street was then opened up for traffic.

After one month of traffic a second coat of Tarvia B and screenings was applied and the street completed.

There is no doubt that a reasonably cheap and durable road had been built. It is sanitary, waterproof and of high tractive quality.

When it is realised that such excellent results can be obtained by constructing macadam roads in a scientific manner there should be no excuse for the extra outlay upon pavements of different kinds. Moreover a macadam road can be dug up and repaired without any real injury being done so that a good road may be laid along a street without the extra capital outlay for sewer and water connections being necessary at the outset.

The general tendency under present circumstances is to curtail expenditures and economise. The macadamised road properly constructed and surface treated should therefore come into its own.

Road Maintenance in Quebec

(Contributed)

During the last three working seasons the province of Quebec has made tremendous strides in the matter of road construction, and it is to be hoped that the Government will not stay its hand until it has brought to a measure of completion the work it has set itself to do. When all the well settled portions of the province have been provided with a fairly complete system of improved rural roads, the saving to the agricultural community in time and wear and tear of horses and gear, will total a very large amount. The effect in retaining the young men and women in agricultural pursuits by improving their social and educational opportunities will also make for the solid prosperity of the province, the gains in this direction being more than the original cost of the improvements. Further, the effect upon local and tourist motor traffic is not to be overlooked.

One feature, however, appears to have been left out of consideration in the original scheme—a matter which demands the immediate and serious attention of the Roads Administration. This is the burning question of maintenance, or rather lack of maintenance. Unlike the Portland cement concrete structure, which improves with age from the day of its completion, a macadam road is at its best within a very short period after its completion, and thereafter is subject to decay and disruption whether used or idle. The elements conspire against it; those who benefit by it and use it often abuse it remorselessly, persistently, and with an utter disregard of its value and service to them. A farmer so shiftless and indolent, and a motorist so careless and indifferent of their respective machinery investments would be more or less of a scandal, to be apologized for by their neighbors and friends. But even without the inexcusable abuse to which it is usually subjected, a macadam road, no matter how perfectly designed and constructed, will not long remain in a satisfactory condition without proper maintenance, and in many cases will become utterly disreputable in a surprisingly short time. Money properly spent on maintenance is money saved.

The province of Quebec has now a respectable mileage of macadam and gravel roads such as any country might justly prize. Without any special publicity campaign the people have embraced the opportunity afforded by the Good Roads Act of 1912 so widely that the newly organized Roads Department has been swamped with such a volume of work as would well have staggered a much larger, more thoroughly organized and experienced combination. The absolutely necessary clerical work in the Department has constituted a tremendous burden upon the shoulders of the Deputy Minister and the heads of the various subdepartments, and we have reason to know that these responsible officials have worked overtime and nights constantly through the whole construction season in order to keep up with the great volume of work. Whether or not a re-organization or a simple extension of the personnel of the Department is necessary we do not presume to suggest, but we believe that the immediate organization of maintenance work on an adequate and efficient basis is imperative. If it be possible that the Government is not yet seized of the vital necessity of this work, and has not settled upon a plan of supervising and financing it, then it is high time their responsible officials, backed by the undivided and solid support of all interested in the ultimate success of the Good Roads Movement in the province, pressed it upon them in so impressive a manner as will compel attention and action.

The approaching Good Roads Congress in Montreal will give a timely opportunity for a thorough discussion of this important matter. We look forward to an official announcement being made that adequate measures for maintenance are being taken, failing which the Government should take this opportunity of memorializing the Government and supporting their suggestions by a strong deputation.

Better Highway Bridge Building

By A. W. Connor, B.A., C.E., A.M. Can. Soc. C.E.*

A good road and a poor bridge is an anomaly. In view of the large expenditure required for bridges in Good Roads systems, a discussion of some points in connection with bridge construction may be of interest to municipal bridge committees and road superintendents.

The Old Bridge

Most of the old bridges in this country are of wood, or of wood and steel, and were built for much lighter loads than now prevail. In general their days are numbered. The old steel bridges are mostly of the pin connected type, and are too light. Some of these might be rebuilt for shorter spans, with a new floor system, but putting in a new floor system and concrete floor in an old bridge, without a thorough examination as to its carrying capacity, is very risky. It is very unlikely to be capable of carrying a floor three times as heavy as its original one. The investigation should include measuring and examining all main members, especially adjustable ones, all joints, sizes of pins, arrangement of bars or pins and calculation of bending moments in same, examination for rust around pins, and, where water may collect, examination of shoe plates and rollers.

The New Bridge

The kind of bridge, the span, the width of roadway and kind of pavement should be determined by local conditions, the nature of the foundations, waterway required and relative costs. The question of aesthetics should in future receive much more attention than it has in the pioneer days of bridge construction. The structure should conform to the surroundings, and be treated in a simple, not in an ornate, manner. Reasonable extra cost is justified in permanent structures, as "a thing of beauty is a joy forever," but a monstrosity is a perpetual eyesore.

The question as to how much more should be paid to obtain a permanent, instead of a temporary, structure may be figured out by computing the amount of the difference in first cost and any annual difference in maintenance at compound interest during the lifetime of the temporary structure, and equating it to the cost of a new one. Thus (if difference in maintenance be omitted) one might pay three-eighths more for a permanent structure, if interest be at 4 per cent., or one-third more at 4½ per cent., than for one lasting twenty-five years. In general one might pay more, as the maintenance charge would likely be less. As the premises are somewhat variable, the figures are only approximate. Exception is sometimes taken, however, to building for posterity.

Substructure

Abutments, wing and retaining walls, and piers are now nearly all built of concrete in mass, or of reinforced concrete. A small amount of steel is, however, advisable in the former, to prevent temperature or contraction cracks. The relative costs of concrete and steel at the site is the determining factor. Stone masonry is now generally superseded by the cheaper concrete. Steel cylinders, well braced together and filled with concrete may still be used, but lack the stability of heavy piers against jams of ice and floating debris. Wing and retaining walls are required to protect the earth fill in the approaches. They may be flared out and have sloping tops to suit the fill, or run back parallel with the road (forming a U abutment). The latter are now the most common, as they provide for handrailings, are readily lengthened if required, and have a better appearance. Where the embankment is high, and there is little risk of erosion, wings or core walls are built from the centre of the T abutment, serving to steady the same. Retaining walls should be tapered at least on the back, so that frost action will force the earth up instead of spreading the wall. Expansion joints should be made about every 25 feet to 30 feet and drainage from the back

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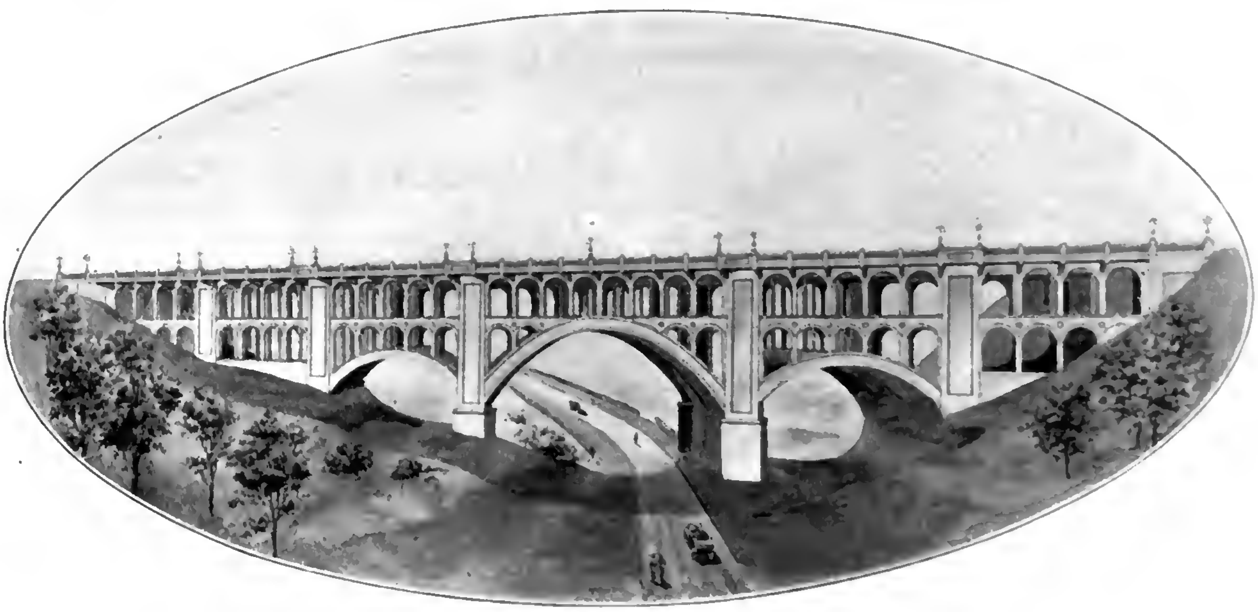


Bloor Street Viaduct design in concrete, Rosedale section.

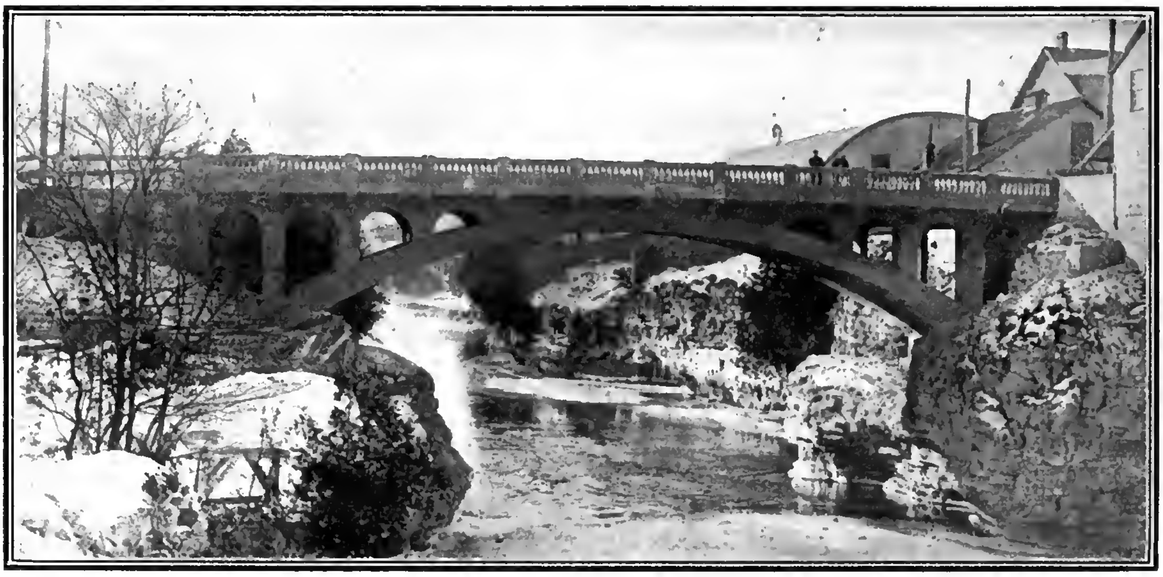
of the wall provided for. A coating of water 1 inch thick would exert as great pressure as if it were a mile thick. If the stream does not strike the line of the roadway square, it may be necessary to build the abutment or pier on the skew, or lengthen the span. This involves extra cost.

If solid enough foundations are not obtainable at reasonable depths, it may be necessary to drive bearing piles, or carry the foundations down to a solid substructure by means of pneumatic caissons, if the depth below water level is considerable. Wood and concrete piles (either cast separately or driven, or cast in position) are used. If provision against possible undermining is required, steel interlocking sheet piling or the wood piling of the cofferdam may be driven down.

Superstructure

The materials available are steel, concrete, masonry and wood. The last two are seldom used, masonry on account of its cost and wood on account of difficulty in getting suitable quality, and also on account of its temporary nature. Steel and concrete are strong competitors, both being excellent materials when properly used. Local conditions in all cases will determine which is the best to use. Concrete structures may be of either mass concrete or of reinforced concrete. The former is very much heavier than the latter and is seldom used for superstructures. The "raison d'etre" of reinforced concrete is the fortunate provision of nature that both steel and concrete have the same coefficient of expansion or they could not be used together. Steel is our best material for tension, and concrete in general best for compression, price considered. Concrete superstructures are of slab, beam or arch type, and occasionally cantilevers. On account of being cast as monoliths, concrete slabs and beams are generally continuous, a distinct advantage both for economy and rigidity. Arches must be built on unyielding foundations or provision made for taking up the thrust by steel embedded in the floor of the stream or through a concrete floor suspended from the arch ribs. The latter type of arch is getting to be very popular for spans too long for beams, and where small headroom for waterway is available. The arch has a decided advantage in appearance, if properly treated. The flat surface of the beam bridge, combined with the same in the abutments is very monotonous and requires panelling, or the use of an open type of handrail. An inexpensive type of the latter, consisting of separately cast railings and posts has been used by the writer on various occasions.

The generally accepted advantages of reinforced concrete are: permanency; small cost for maintenance; greater adaptability to architectural treatment; rigidity with lack of noise under traffic; employment of local labor in construction and keeping most of the money in the locality; the cement is made in Canada, while structural steel is all imported. These advantages are however lost unless all work and materials are in strict accordance with plans and specifications. Careless inspection is more disastrous to concrete than to steel. The advantages of steel are: it has no competitor for very long structures, or for long beams with limited depth; greater adaptability to all kinds of trusses and forms of construction; greater uniformity of material and consequent less danger from faulty inspection. It is the lightest structure that can be built.



Tower Street Bridge, Fergus, Ont.

The various types of steel superstructures are: beams, plate girders, trusses of various kinds, arches, cantilevers, suspension and swing bridges.

Length of Span

The span is determined by estimating the total cost of larger spans with fewer piers or shorter spans with more piers; by the location for the safest position for piers, and by the consideration of the amount of waterway required to take care of the greatest floods likely to occur. In general, the most economical arrangement is when the cost of substructure and superstructure are about equal. The determination of waterway necessary requires careful study. Enquiry should be made from old residents as to how neighboring bridges carry the floods, having regard to their spans and relative drainage areas. This can be supplemented by calculations from drainage area, maximum rainfall, runoff and slope of the stream. Maximum rainfall is subject to great variation and judgment is required as to how much waterway should be provided for, without undue cost. Allowance should be made for piers, causing jams of ice and floating materials, and for the fact that floods are apt to be greater now that the country is cleared and drained. It is unwise to reduce the waterway, as a municipality may thus be held liable by the courts for damage to property through floods.

Loads

The bridge should be designed to carry, with a factor of safety of 4, any loads likely to come on it, and to allow for future increases. There has been a rapid increase in the weight of traffic in recent years. It is expected that the maximum legal weight that may pass over bridges is to be twelve tons, so provision for fifteen tons at least should be made now for country roads.

Width of Roadway

Likewise, greater width of roadway should be provided on permanent bridges. Country bridges on improved roads should be 18 or 20 feet wide. The roads may be widened when required, but the bridge cannot be.

Duties of Engineer

It may be of interest to state the duties of the engineer. He should examine the site, test the foundations, make surveys and gather all available information. He should make estimates of the cost of the various propositions and advise as to the best. Prepare plans, making all calculations as to stresses and sizes of material required, stability of foundations, and so forth. Prepare specifications, instructions, with estimates of quantities for contractors and forms of tender. Advise as to the letting of the contract, draw the contract and prepare any further drawings required, or check over any prepared by the contractor. In the case of a steel bridge it is important that the detail joints should be of full strength (a matter often neglected). Inspect the work during construction and generally see that everything is carried out strictly in accordance with the contract. Issue certificates for payment, and for the final acceptance of the work.

The too common practice of asking contractors to submit their own plans should not be continued. The only way to determine the best tender is to have all bid on the same, unless the engineer reports on each plan (a rather laborious undertaking). It is assumed, of course, that the engineer is an expert and that his plans are both theoretically correct and practically feasible and economical in construction. Cheap advice, as in everything else, may be very expensive in the long run. There are a lot of weak bridges, said to be standing only from the force of habit. There should be some government inspection or regulation requiring county engineers to report faulty structures in all cases where human life may be risked.

A Satisfactory Paving Material

By J. F. Rhodes*

THE time has arrived when good roads must be built. The people are now educated in regard to road value from the standpoint of financial gain and the social advantages of the rural people. The graded earth or gravel road no longer fulfils the demands of traffic. These types provide only seasonal roads, which the public no longer desire. This condition makes it necessary to adopt durable roads of the hard surface type.

Formerly, farmers objected to hard surface roads, claiming they were too hard on horses' feet, but they now realize that a good hard surface road, usable every day in the year, is such a great advantage that this objection is negligible.

In adopting the hard surface road (that composed of stones) the road builders' problem is to select a binder that will keep the stones in place. The automobile, being driven by the rear wheels, soon loosens the stones in a loosely bound road, causing the road to ravel and rut. To overcome this trouble the binder used must be rigid and permanent. Portland cement is the only binder that meets these requirements.

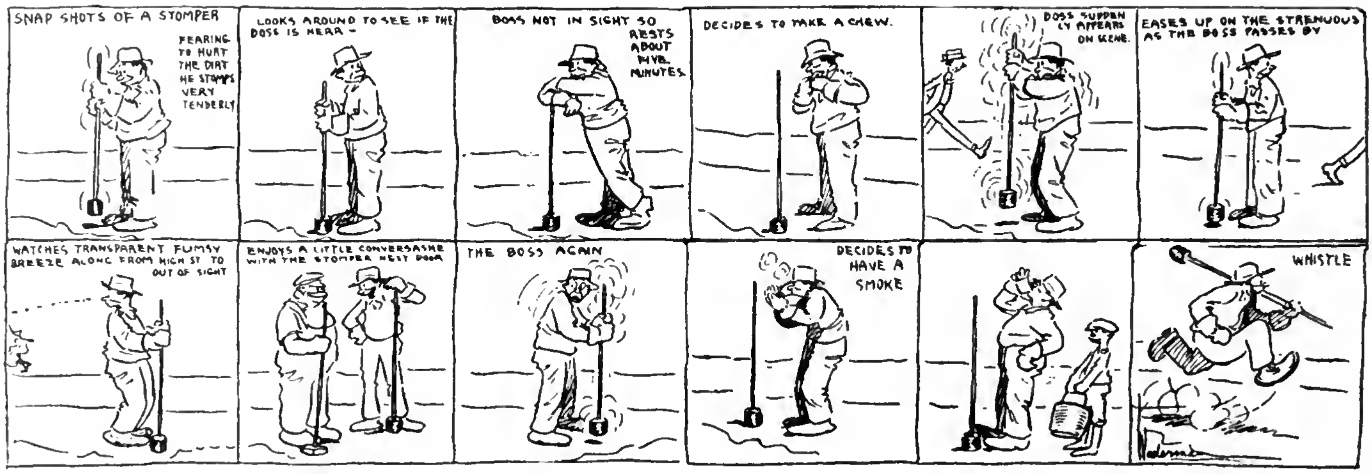
Quality

Portland cement concrete makes a road of the highest quality. It fulfils all the advantages required of a good road. By having a low crown, being smooth and non-slippery, it forms a road surface which is very favorable for travelling. As concrete wears very slowly by abrasion, a concrete road does not form dust or mud. The only dirt ever noticeable is that carried upon it from adjoining earth roads, which is readily removed by the wind and rains. Another valuable quality of a concrete pavement is its ease of maintenance. The contraction joints and any defects which may develop due to poor construction, are repaired with bitumen and sand or stone, and is a very simple operation. Repairs are also very slight, seldom costing over $25 per mile per year, and can be done without closing the roads to traffic.

Economy

Present conditions demand economy, not retrenchment, in expenditures. Money should be invested, not spent. Roads should be constructed which are economical when considered as investments. Investigation will show the high initial cost, cheaply maintained road, to be an economical investment, and the low initial cost, expensively maintained road, a costly expenditure. Concrete roads can easily be maintained for the life of at least twenty-year debentures for $50 per mile per year. Wayne County, Michigan, maintains their concrete roads for $25.50 per mile per year. The average yearly cost for maintaining the macadam types used in New York and Massachusetts is over $600 per mile, and these roads require rebuilding every ten years. Assume, for example, a concrete road surface can be constructed for $14,000 a mile and can be maintained for twenty years at a yearly cost of $50 per mile. The money to build the road is obtained by issuing twenty-year debentures. It is essential that the road be maintained every year, that the interest (assume five per cent.) on the debentures be paid yearly and enough money procured by yearly payments to rebuild the road in twenty years. The total yearly cost for this perpetual improvement is $1,173.40. A road of the macadam type can be constructed for $8,000 per mile, and can be maintained for ten years at a yearly cost of $500 per mile. Ten-year debentures are issued to build this road. The total yearly cost for this perpetual improvement is $1,536.04. The com-

* Publicity Manager Canada Cement Co., Ltd.



Good Roads Movements. By courtesy Municipal Engineering.

munity by building concrete saves annually $362.64 per mile. Choosing this road would certainly be economy.

Permanence

The permanency of concrete road is unquestioned Concrete paving which has been in use many years shows practically no signs of wear, as instanced in Bellefontaine, Ohio, where it was introduced in 1893, and Wayne County, Mich. Wayne County built 2½ miles on Woodward Avenue in 1909. This road has had very heavy mixed traffic. A census taken in 1913 showed a daily average of 320 horse-drawn vehicles and 2,290 automobiles. This road proves the permanence of concrete roads for all classes of traffic. The following paragraph is taken from their Ninth Annual Report, dated Detroit, Mich, December 20th, 1915.

"With the exception of the finishing up of the small stretch of brick roadway on Gratiot Road (let by contract) and 643 feet of gravel construction on the Ford Republic Road, all of our work is of our standard concrete construction and has been done under our own supervision and jurisdiction by our own forces. We have made no changes in our concrete specifications as we feel that the manner in which our concrete roads have stood the test of time and use during the past seven years and the small amount spent annually on their upkeep is ample justification for our adherence to the specifications we have evolved and the methods we have followed in their building. We have never taken up and replaced a twenty-five foot section since we have been building and developing this type of road, and its freedom from ruts and holes has permitted us to devote our energies and moneys to new work instead of resurfacing and repair work, which forms so large a part of the activities of other communities where a less durable type of road has been built at the outset."

Satisfaction

Concrete roads embody the three characteristics essential for a satisfactory modern highway: quality, economy and permanence. Permanent roads make the country property more valuable. Economical improvements make the people wealthier, and these advantages, combined with the high quality of concrete roads, completely satisfies them. When people are satisfied with an article they purchase it again. When the road builders give the public roads which are satisfactory the whole country will be lifted out of the mud in record time.

Canadian Brass Company, Limited

The Canadian Brass Company, Limited, Galt, Ont., are preparing a new catalogue covering their various products which will be of great interest to the trade. The products of this well-known company comprise corporation brass goods and plumbers' supplies. In connection with the first they make the well-known line of "Canadian" main cocks and curb cocks, lead unions, lead and iron unions and service boxes. Their curb and main cocks are equal to the best quality produced in Canada. They are all ground key work, i.e., after the cock body is reamed and the key or plug is turned on a lathe they are then put in what is called a cock grinder and every plug is ground to fit the body. This has to be done by a practical mechanic. When a perfect "ground fit" is accomplished the plug or key is thinly coated with a specially prepared grease that is guaranteed not to harden. The complete cock is then subjected to an hydraulic test, and if it does not show any leak, either through the metal body or around the plug, it goes to the field. What such careful work means to a corporation can be surmised if one considers that it costs more to dig up and replace a defective cock than the article is worth.

The lead and iron unions and service boxes of designs sold by this company for years have been universally accepted as high grade by many of the municipalities. In plumbers' supplies they also make the "Adanac" bath and basin cock. These two lines are probably as well known among the high-class plumbing trade in eastern Canada and parts of the west as any bath cock on the market. They are of red metal, carefully polished, carefully assembled and then nickel-plated, the majority of the trade buying them with porcelain index handles. These articles are subject to two tests, one when the casting is rough and the other when it is finished.

To fill out their line this company manufacture in the same careful way compression bibbs, sink cocks, drain cocks, comp. bath and basin cocks, gas cocks, round and straightway service cocks, either lever or tee handle, with the "Canadian" patent cap.

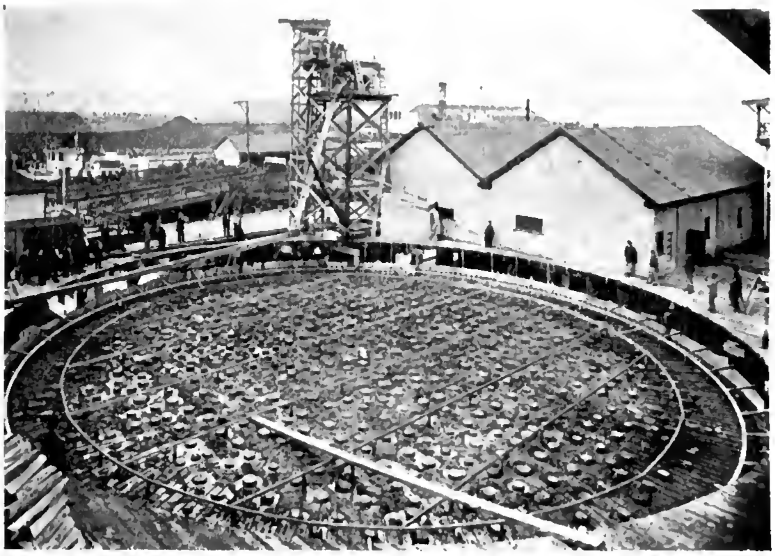
The plant of the Canadian Brass Company has been in operation in Canada for about nine years, and is splendidly equipped.

The Imperial Oil Company have awarded the contract to the London Concrete Machinery Company to supply two half-yard batch mixers to be used on their new plant at Regina.

Foundation and Fire Wall for Oil Tank

The accompanying illustration shows the foundation of a thirty thousand barrel oil storage tank at the Grand Trunk Pacific Railway wharf at Vancouver, for the Imperial Oil Company, Limited. The placing of the concrete was handled in a very economical manner, as described below:

After the piling was all completed, the hoisting tower was erected and the hoist motor put in place. The sheave supporting beams were made longer than usual and temporarily placed on the top of the tower and allowed to project over the mixer platform; the mixer and its motor were then hoisted in a few minutes by the hoist motor. The height of the mixer platform was so arranged that when the form-work for the fire wall was completed the mixer was at the correct height for discharging direct into buggies; at the same time it was of sufficient height to spout the concrete for the tank foundation, which is two inches thick. The tower was placed just over the outer edge of the wharf, so that the hoisting skip can be lowered to suit any stage of the twelve-foot tide. The scow was brought direct from the gravel pit, and on it was placed the cement which was received from the cement boat, which brought cement straight from the cement mills. The correct amount of aggregate and two sacks of cement was then dumped by wheelbarrows into the hoisting skip, which was hoisted and discharged into the mixer.



Concrete Pile Foundation for a thirty thousand barrel oil storage tank.

The specifications for the material for the foundation slab called for a mixture of 1-3-5. By measurement it was found that three cubic feet of sand and five cubic feet of gravel, when thoroughly mixed, measured seven cubic feet. At the gravel pit the correct amount of gravel and sand were discharged from different hoppers on to a belt and loaded on the scow. Care was taken, with the result that the material was very evenly mixed. The result of having the material mixed at the pit was that it was much more easily handled at the job and also one yard of mixed material equals one and one-seventh yards of separated material. From the above description it will be noticed that the only plant used was the hoist mixer, which is an important consideration when only handling a thousand yards of material. The contractors were the Dominion Construction Company, Limited, Vancouver.

Revision of Canadian Society By-laws

H. B. Muckleston, M. Can. Soc. C. E., has been nominated by the Calgary Branch and endorsed by the Edmonton Branch as one of the members representing District No. 6 on the Committee to consider the revision of the by-laws and other matters as set forth in a resolution adopted at the last annual meeting of the Canadian Society of Civil Engineers. Mr. Muckleston is a past chairman and a present member of the executive committee of the Calgary Branch. He has always taken an active interest in the affairs of the Society and will, if elected, make a valuable member of the committee.

Good Roads Men Want Duty Removed

The Manitoba Good Roads Association, with S. R. Henderson, president, in the chair, held a meeting in the Industrial Bureau February 24, at which the following resolution was passed:

"Whereas, it is to the interest of all residents in the Dominion of Canada to secure at the lowest possible cost the best road-making materials available, and as asphaltum oil and its by-products are valuable road-making materials and produced chiefly in the United States of America, it is the opinion of this association that this material should be admitted free of duty for road-building purposes; and it is hereby resolved to petition the Dominion Government to pass such legislation as will allow the free importation of such asphaltum oil or any other oil that may be used for road-building purposes."

It was decided to bring the foregoing resolution before the attention of the Canadian and International Good Roads Congress, which meets in Montreal, March 6, when W. F. Tallman will represent the Manitoba Good Roads Association.

Split-log Drag Competition

The question of split-log drag competitions was also discussed at some length.

Mr. A. McGillivray, highways commissioner, expressed the opinion that these competitions should be treated from a purely business standpoint and not entirely with the idea of winning prizes. It should be in the interest of all municipalities to maintain and improve their roads, added the commissioner, who stated that the government was ready at any time to help along the work in every possible way.

It was ultimately agreed to appoint the following gentlemen to wait on the Minister of Public Works regarding some definite line of action: Mayor Waugh, S. R. Henderson, A. C. Emmett and Reeve Haddow

Mr. Thornton on "The Development of the Mountain Park Coal Field"

Mr. N. M. Thornton, C. E., General Manager of the Mountain Park Coal Company, Limited, addressed the Edmonton Branch of the Canadian Society of Civil Engineers, at their regular meeting held on the 16th February. His subject was "The Development of the Mountain Park Coal Field." This property is located about 75 miles south of Edson on the Grand Trunk Pacific Railway. Mr. Thornton's address was illustrated by numerous photographs showing the various features of interest in the development of the field, and was greatly enjoyed by those present.

The Ontario Good Roads Convention

Most Successful in History of Association—Record Attendance and Splendid Enthusiasm—Important Topies Discussed by Best Men in the Business

THE 14th Annual Meeting of the Ontario Good Roads Association, which was held in the York County Buildings, February 22, 23 and 24, was largely attended, the number of delegates present from all parts of the province being the largest in the history of the Association. The total registration was upwards of two hundred.

President's Address

President S. L. Squire, of Watford, opened the proceedings with a short resume of the work accomplished during the year and outlined the aims of the Association for the future. Dealing with the expenditure of the people's money after the war, Mr. Squire favored the erection of highway memorials at different points throughout the province commemorating the work done by our Canadian soldiers in the present war and providing a means for employing a part of the great army of men and immigrants who will return to Canada after the victorious termination of the struggle. Even in a period of comparative financial stress like the present the work of provincial improvement should go ahead. Among other provincial works suggested by Mr. Squire was the building of a great through highway between Ontario and Quebec which should conduce to mutual trade and better social relations between the two provinces.

Limit Motor Loads

Mr. George S. Henry, M. P. P., secretary-treasurer of the Association, presented a bill to limit the weight to be carried on country roads and bridges by motor vehicles. This bill was referred to a committee for discussion and the wardens of the counties were appointed a special committee to forward legislation looking to the improvement of county roads.

Afternoon Session

Alderman J. G. Ramsden, together with Acting Mayor John O'Neill and Controller Thomas Foster, represented the city council and welcomed the delegates to the city. Alderman Ramsden, referring to the Toronto-Hamilton Highway, said that Mr. Gooderham had acted in good faith when he estimated the cost of the Highway at $600,000, but he was not a practical road man and must have been poorly advised. Mr. Ramsden expressed the opinion that before the Highway was completed it would probably cost $1,000,000, but whatever the cost, the work will have to go through now.

Knowledge Gained by Experience

Knowledge gained by experience was the warning taught by Sir John Hendrie, who spoke briefly, welcoming the Association, and, in passing, touching on the cost of the Toronto-Hamilton Highway: "I can speak feelingly of the cost of the Highway for I am a taxpayer in Flamboro and have to pay my share of the assessment. The province must soon spend millions on its roads; let us learn the lesson of the need of employing the best technical skill to estimate the cost of the work and supervise the construction."

The Lieutenant-Governor also spoke of the effect of good roads in improving social and farming conditions in the country and hoped that it would not be long until every road in the province would be greatly improved.

Why Counties Have Not Adopted County Road Systems

Mr. K. W. McKay, vice-president of the association, touched on the splendid system of highway laws as at present in force in Ontario, before calling on representatives of the counties, who had not adopted the good road system, to tell why they had not. Mr. John A. Best, M. P., speaking of the good roads system in the county of Dufferin, partly blamed the past relationship with Simcoe and Welland for not having gone into the matter. Mr. Best spoke forcibly of the good effect of better roads between the farm and the market towns to the farmer. Perishable produce is often spoilt, due to the fact that the farmer can't market it immediately on account of the bad roads. The system of statute labor should be a thing of the past. Under the present system some parts of the road are looked after better than others. War conditions need not seriously interfere with the establishment of a good roads system. If the statute labor system could be gotten rid of and the good roads system applied, the question would be generally solved. The question resolves itself into educating the people to the benefits to be derived. Until recently the country people have been very much prejudiced against the motors and have been averse to taking up good roads, but they are beginning to see the benefits of them and it is the duty of this association to further that education.

The item of the cost and the fear of the ballot box has led many government members to play safe rather than to take a stand on a question his constituents might not understand, even though it be ultimately for their own good. The Government pays 40 per cent. of the cost of new roads and the people are doing themselves a great injustice not to take advantage of the opportunity. Everybody pospers when the farmer prospers. It's up to the farmer to take advantage of the opportunities offered.

Situation in Elgin County

Mr. N. F. Cornell, of Port Stanley, explaining the situation in Elgin County ascribed the trouble to lack of education on the part of some of the county councillors and to the mistaken idea held by some counties, where material was plentiful, that they could build cheaper themselves than by contributing and working under the supervision of the Government.

Owing to the lack of sufficient data on the cost of roads in different counties, and the present financial crisis due to the European war and the eternal fear of the ballot box the system had not as yet been adopted by the county council of Elgin—the home of the Minister of Works and the Deputy Minister of Highways.

Dr. Meek of Port Rowan, past member of the county council of Norfolk, spoke of conditions there.

Some well populated counties have lots of good readily available material, with which to build good roads, while other sparsely settled counties lack not only the money but also the material. This with the advent of motor traffic, the present war and the inadequate education of the county councillors, who feel that good roads are a luxury rather than a necessity, prompts the wait-and-see attitude, and is the reason why many counties haven't been progressive enough to take the step in advance.

Don't Know the Cost

Warden McDowell, of Norfolk, in defending their "play-safe" policy stated that they weren't sufficiently informed on the cost of roads. Estimates had been submitted to them, which when gone into were only about one-third of what they should have been. The big item was the expense of materials which were not very convenient and necessitated long haulage.

People Need Educating

Mr. Anderson, also of Norfolk, in behalf of good roads mentioned the difficulties to be overcome, but stated that they could be overcome if the government would send a representative out to meet the people in a convention and show them the benefits to be derived.

Kent County Would Benefit

On behalf of Kent, a flat low-lying country, Mr. G. A. Frazer, of Thamesville, stated that no county would benefit more than Kent by a good roads system. The increase in property value would more than recompense for the extra taxation. But the people, now under a heavy drainage tax on account of the low flat nature of the country, could see nothing more than increased taxation. They have to be educated to the economical benefits to be derived in increased land values, due to better production, from better drainage, better transportation facilities, the increased comfort and the moral effect on the rising generation. Kent is somewhat in the position of the man who owned a gold mine but wouldn't spend enough to buy a pick and shovel to work it. Educate the people who may choose men whom they know will carry out their best interests regardless of consequences.

Want Concrete Roads

Mr. Hennigan, warden of Kent county, stated that, due to the flat nature of the country, the only roads they considered at all permanent were concrete, and so far they were marking time until they saw some examples of it.

Proper Handling of Highways

Mr. W. A. McLean, Deputy Minister of Highways, was loudly applauded when he rose to address a few remarks. The public highways have always been with us and always will be. Every man has to travel on them. The great problem of the people is, therefore, the proper handling of these highways. "On the highways of the province," said Mr. McLean, "we all meet on a common level. There is no fee charged. There is no ticket to purchase. There is a sense of ownership when a man is on a highway to be found in no other place in this or any other country. Let us make these highways the best we possibly can."

Before January 18, 1916, the Highways Department had never been able to present a fixed policy with regard to the aid they could extend. In 1910 the department was organized, which consisted of Mr. McLean and his stenographer. The government paid one-third of the cost of the construction of new roads. In 1913 a commission was appointed but nothing positive could be said in regard to their policy. In 1914 this commission handed in their report and in 1915 the act was passed, but up to January 18, 1916, nothing definite could be said as to when it would take effect. The first step taken on receiving definite authority was to send out a statement to all the county councils, showing how it would affect them. From the response the department feel it has been very beneficial and this first step will be followed up by others.

Answering a number of questions, Mr. McLean mentioned how difficult it was to state offhand the cost of any particular road. The trouble is, a county asks for the cheapest road under the regulations, as to cost. When it is started people recognize the room for improvement and demand it, with the result that the final part of the road may be twice as good as the initial part and consequently cost in proportion, but the people don't at once realize why. With good roads a farmer can produce a maximum and sell it immediately. But on poor roads he can only produce what he can transport. It is evident that the good roads will soon pay for themselves in return. Start in cautiously and work up to a system embracing all roads.

The system is not perfect, no human scheme known is perfect, but its good features are vastly in advance of its disadvantages. There are obstacles, but they have their compensation.

The European war casts its shadow, true, but we are all confident of the outcome and should go forward and prepare plans for the time when the war is victoriously over and the great army of men, and possibly almost as large a one of immigrants, come back. We owe them something and the opportunity of giving them employment on highway construction should be our aim.

Mr. McLean assured those present that the Department is always at their service, always ready and willing to meet and advise anyone in regard to the betterment of good roads.

Mr. Merrion spoke of the condition in Prescott and Russell, and the hope they had of effecting a bond between Ontario and Quebec.

Legacy for Posterity

Money wisely invested in providing good roads is one of the best legacies the people of today can leave to posterity, was the keynote of an address by the Hon F. G. Macdiarmid, Minister of Public Works. Good roads were not only a provision for the future, but they increased the value of the farm land and property in general. "Let us make our highways the best we possibly can. Good roads are necessary from an economic point of view whatever the cost."

Mr. Macdiarmid said that in spite of war, the campaign throughout the province to secure more good roads had made progress and it was possible even at such a time that legislation to help further with the work might be passed if the people of the counties would work together and prepare the preliminaries. There had been talk of the country passing through a period of stress and strain, but he believed that the stress was less today than 18 months ago. There was being exhibited by British people everywhere a feeling of confidence that was truly remarkable. Nevertheless it was not a time for reckless expenditure nor was it a time for standing still on the matter of securing better roads. The Government asked for their co-operation and hoped for a period of great prosperity and great immigration after the war and wished to be prepared for it. Highways, the best that could possibly be made, were essential to the success of the province, both from point of view of utility and economy.

The Benefits of a County Roads System

This question was discussed on Wednesday afternoon by a number of county representatives. Major Sheppard, speaking on behalf of the county of Welland, which was one of the last counties to come into the new system, referred to the benefits derived from the system. Since coming into the system Welland has made 162 miles of good roads in the last four years. Before these roads were improved the roads in Welland were about the worst in the province, but since improvement the difficulty is now not to get the people's consent to build more roads, but where to build them, each township clamoring for more in their particular division. Statute labor is unsatisfactory. The time has come when an organized system is necessary throughout the province. The cost of road building per mile is hard to determine without a systematic estimate of local conditions; every mile will cost different, depending on the convenience of materials, length of haul, number of culverts to be placed, and grades and hills encountered. In the county of Welland today, after a few years of Good Roads, there is not a dissenting voice.

Untiring Efforts of County Engineer

Warden Campbell, of Middlesex, one of the first counties to adopt a Good Roads system, in 1907, stated that their success was due to the untiring efforts of their county engineer, Mr. Charles Talbot. Up to the end of 1915, 240 miles of improved roads had been laid, and the programme for 1916 calls for 165 miles more. The cost of good roads in Middlesex is from $1,000 to $1,500 where gravel is convenient, and $4,000 for broken stone roads, the average cost being from $1,800 to $2,000 per mile. Mr. Campbell would like to see a limit put on the load for fast motor trucks. Due to the increasing traffic, these motors are breaking up the roads throughout the country.

Nothing But Praise

Mr. Wheelock, of Peel County, stated that after eight years of experience under the Highway Improvement Act the people of the county had nothing but praise for the system. People are insisting on good roads at whatever cost. In Peel nearly all the roads have been reconstructed, and the question now is mainly one of maintenance. The good effects to be gained from Government supervision, in which the Government pays forty per cent. on construction and new machinery and twenty per cent. on maintenance, should appeal to any progressive county.

The time is approaching when country traffic will be done entirely with motors, carrying an average load of from ten to fifteen tons, and roads must be built now to maintain this heavy traffic in the near future.

Increased Property Values

Mr. W. Anderson, Prince Edward County: After nine years under the county system land values in Prince Edward have increased at least 25 per cent. This should be a big item in influencing those counties not yet under the system to take it up. The cost in Prince Edward averages from $2,200 to $4,000 per mile, depending on the kind of land over which the road is built and the convenience of the building material.

Wentworth County

The county of Wentworth, which receives some of the heaviest traffic of the province, due to the fact that it lies in the path of traffic passing between Detroit and Niagara Falls, has been working under this system since 1902, and have spent about $378,000 on county good roads. The system now is in very good shape, 153 miles of improved roads having been laid. The social and moral advantages claimed for this system, and the increased value in land, are great assets to the county. When it is considered that 240,000 acres have increased in value from $2 to $50 an acre, one will see the good effects of such a system.

Cost $1,500 to $4,000 a Mile

Mr. Pugsley, of York County, the pioneer county in Good Roads systems, spoke of the attempt made ten or twelve years ago to have good roads over all York, and the subsequent division into north and south when the system was turned down—the southern portion adopting the system, and the northern staying out.

Good roads in York have cost from $1,500 to $4,000 a mile. The fact that most of these roads lead to Toronto, and the excessive nature of the traffic, has necessitated a very permanent form of construction. About 115 miles of roads have been constructed, at a cost of approximately $600,000.

North York, realizing the advantages of the new system, were unanimous at the last meeting of the council to adopt Good Roads. Mr. Pugsley would like to see all the counties adopt this system, and have good roads from one end of the province to the other. It would not only be an economic benefit to the people, but also a benefit from a military standpoint, due to the great advantage of rapid transportation.

Hastings County a Pioneer

Ex-President Vermilyea, of Belleville, representing Hastings County, which was one of the early pioneers in the good roads movement on which it had spent two millions of dollars before the Government had made a grant, advised other counties to follow suit. Begin now on roads nearest the respective market towns and progress year by year as finances would allow and forget that it was a stupendous task, was Mr. Vermilyea's advice, for in years to come, he said, the saving in horseflesh, labor, and increase in farm values would soon repay more than the roads would cost.

Land Values Increased 25 Per Cent.

Mr. Willoughby Anderson, Prince Edward County, said his county adopted a good road system nine years ago, and in farm centres the land values had since increased as much as 25 per cent.

Good Roads Sign of Prosperity

Mr. C. R. Wheelock of Dufferin County, expressed a similar view, and advised the counties to build their roads to meet heavy traffic for heavy motors would be the chief means of transport in the near future. If the counties, still years behind the times, would adopt a good road system the townships would follow suit. Good roads were a sure sign of the alertness and progressive spirit of the farmer.

Financing Good Roads

Mr. K. W. McKay, St. Thomas: Good roads are investments and must be paid for; there are no bargains in road building. The question resolves itself into one of legislation and our present laws are evidence of our aim to provide better equalization; to derive the funds from the proper source. That the Highways Improvement Act has only been adopted in one-half of the counties suggests that increased legislation is needed. With the improved county roads, both the country and city resident benefits by the results of improved transportation facilities.

Mr. McKay believed that the present legislation is somewhat inadequate. Townships should pay according to the benefits derived, and should assess the land as they derive benefit from the road. A man on a back road does not get as much benefit as the farmer living on the improved highway. The assessments should be made on benefits derived rather than on frontage. Under the new regulation the government pays 20 per cent. on maintenance and 40 per cent. on new construction, also 40 per cent. on new machinery. Provincial aid is extended in the case of country roads, suburban roads and main highways—that is between cities. The Department encourages the adoption of the system and the appointment of road superintendents.

Highways are classified by the traffic thereon, and the ways in which they are improved. Maintenance is the keynote of a good roads system. It should start as soon as the new road is finished. Counties carry on their road improvement financially in three ways—first, by an annual levy, which is employed by seven counties; second, by a combination of annual levy and debenture issues—three counties employ this system—and last, by debenture issues alone, which seems to be the popular system, ten counties having adopted it. The time limit of the debenture is set by the department. It would be unwise to extend them beyond the reasonable life of the highway.

In conclusion Mr. McKay said, (1) Give the counties time to study the system and inaugurate it; (2) Have proper provision in the Highways Act for the township to pay in proportion to the benefits derived; (3) Have the Department supervise the issue of debentures and (4) Build the best road possible, as the most expensive first cost highway is the cheapest in the end.

When Are Gravel Roads Profitable?

By Chas. Talbot, C. E.*

A good road gravel is composed of hard and tough pebbles and stone of different sizes and sufficient sand and binding material that when consolidated in position on the road it will form a solid mass.

Where large stones are found in a gravel pit they should be removed before loading the gravel and where a large proportion of the gravel is composed of large stone the whole of the material should be run through a crusher and screened, the excess of sand resulting from the screening may be placed in the base of the road with the larger stone and on top of this the smaller stone filled with sufficient filler from the small screen. Where gravel deposits have not sufficient binder to consolidate the necessary binder will be produced by passing the material through the crusher.

In the construction of the gravel road the subgrade should be firm and the gravel deposited and rolled in layers of four or five inches and finished by using a moderate amount of rolling and watering. A gravel composed of large stone and fine sand is very objectionable and results in inferior work. Gravel composed of small pebbles coated with an iron oxide or a clay binder sets readily and produces a very serviceable road for light traffic.

The more difficult it is to consolidate the gravel the harder and more durable is the surface formed. The gravel that has an excess of binder dissolves easily under traffic in wet weather and ruts are formed; is may however be restored with a grader or log drag if used at the proper time. This cannot be done with the better class of gravel and the ruts and depressions must be filled with fresh material.

In the construction of gravel roads the roller is useful to consolidate the grade and roll the gravel sufficiently to form a reasonably firm surface. After this is done I am inclined to the opinion that further rolling is not beneficial as it apparently requires the action of the traffic upon the small stone to produce the binder that results in its final consolidation.

The selection of suitable gravel, the treatment necessary and the quantity used must all be decided by the person in charge of the work and his decision will depend upon local conditions. When traffic is heavy and liable to increase gravel should not be used in new work.

Upon highways adjacent to cities such as Toronto, Hamilton and Buffalo and throughout the counties connecting these cities, traffic conditions are quite as congested as they are on city streets. Consequently they and all such roads must be treated in a class entirely by themselves and as they at most represent less than 2 per cent. of the road mileage of the Province they are of little importance to the people as a whole except as an object lesson representative of the conditions that will obtain in the near future through a much wider area.

Eight per cent. of the total mileage has a traffic of less than 375 and more than 100 vehicles per day and 90 per cent. has a traffic of less than 100 vehicles per day.

Earth and sand roads compose some 19,000 miles of the total road mileage of the organized portion of Ontario, 20,000 miles are represented as gravel roads, 4,000 miles stone roads; the balance, some 12,000 miles, are unimproved.

From the foregoing you must conclude that while the problem of meeting conditions where traffic is congested is large and ever increasing the subject affecting the greatest number of people of Ontario exclusive of those residing in the cities is the one that deals with the long stretches of country roads where traffic is comparatively light and less expensive con-

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struction answers the requirements demanded of the roads.

Convenience of Material

Where material such as stone and gravel must be transported over the railways or by wagons or tractors over long stretches of roads for the original construction of the road no material progress has been made, the cost being considered prohibitive.

On the other hand marked improvement has been made in every instance where gravel, stone or rock is available within hauling distance of the highways.

As the people who control the matter consider the importation of material for the road crust too expensive, the question resolves itself for the present into a consideration and treatment of the materials available and a systematic use of them to produce economic results.

Where earth roads obtain because of lack of metal the roads will remain unsurfaced until the ratepayer decides he can afford the cost of importing stone or gravel for their improvement, or some method is discovered whereby the clay and sand may be converted into a suitable road crust.

With the gravel road, conditions are different; already long stretches of these roads are constructed and are in serviceable condition, and with a Provincial Department of Highways to supervise and direct the organization plans for the systematic improvement in both townships and counties marked advancement must necessarily follow and at least the foundation work of a complete system of highways in the near future will be constructed consisting of properly formed and drained grades strengthened by the application of such local material as is available and for the time being constituting both the base and wearing surface of the present highway but which will in the future constitute the foundation for the more expensive road surface which will be demanded as the country increases in population and wealth.

For the present however we are compelled by the magnitude of the work and the comparative undeveloped state of the country to utilize the material immediately at hand and with them in so far as possible meet the problems confronting us in the matter of the constructing of new roads and the improvement and maintenance of the old.

Drainage

As this paper is not supposed to treat with drainage or the construction of the grade I must assume that in all cases before gravel is placed the water line has been lowered to at least 3 feet below the top of the grade and adequate provision made by a proper under drainage system to keep the sub-grade free from water; failing this no satisfactory results will be obtained by placing gravel or stone on the road.

I stipulate the use of under drains because the use of an unguarded open drain upon the highway is unlawful and useful only to carry off the surplus water from the adjoining lands. Farmers have long since learned the open drain is serviceable only as an outlet for his under drains and the road Superintendent will after a series of expensive experiments discover the open drain on the highway is useful and jealously guarded by the farmer for the same purpose.

Assuming the drainage is good and the grade properly constructed you have what constitutes the only foundation required for a light traffic. A surface coat of best available gravel or stone is then applied using from 800 to 1,800 c. yards per mile; this consolidated with the road roller or lacking a roller consolidated by the traffic with repeated leveling, produces a road that will be serviceable and that will be maintained with an expenditure of $50 to $100 per mile per year.

Such a class of construction will meet the requirements of roads where traffic does not exceed 100 vehicles per day and represents approximately 90 per cent. of the total mileage. There remains however approximately 8 per cent. of the total mileage with a traffic from 100 vehicles to 350 vehicles per day which is a more serious and difficult problem.

Here as in the former case the drainage and grade must be considered the most important part of the foundation. In order however to sustain the increased number of heavy loads, the most destructive auto traffic and the excessively loaded and rapidly moving auto truck, the foundation must be strengthened by a depth and width of metal suitable to the traffic requirements. Where traffic exceeds 200 vehicles or where the greater portion of the traffic is composed of heavy loads a double track road should be constructed say 12 or 14 ft. wide while on the roads of less travel an 8 or 10 ft. road will suffice.

Subsoil

On the subsoil will depend the depth of metal required. Sand and gravel subsoil will require a lighter base of gravel while open loam and certain clay subsoils require a greater depth. It is impossible without extensive experiments to ascertain the approximate depth required. This however, is a matter of no serious import as an additional depth may be added where conditions demand at a price equal to the cost of the original construction.

The most economic plan would be to err on the light side provided the defect is detected and remedied before the gravel is forced into or mixed with the subgrade which is a matter easily detected and prevented. The piling on of gravel or stone to an excessive depth without first ascertaining what depth of metal is necessary is a matter where thousands of dollars may be wasted without a possibility of a return for the expenditure.

After a roadway has become firm and ceases to yield under traffic only sufficient new metal should be used to maintain the crown to its original form and fill the depression that may develop. Such a process will require an expenditure of $75 to $150 per mile per year.

An old gravel road which has been properly constructed and reveals a considerable depth of gravel in the foundation should be repaired by removing the shoulders and adding a sufficient amount of gravel to complete the crown. Where the old deposit of metal has worn excessively or is mixed with the sub-grade better results will be obtained by adding sufficient metal on top of the old gravel to restore the crown. The gravel required to construct a road 12 ft. wide at $1.00 per cubic yard will cost approximately $3,000 per mile. A road 8 ft. wide will cost about $2,000 per mile and the resurfacing of the worn road about $1,000 per mile.

Until this year no systematic attempt has been made to encourage or organize an effort looking toward the maintenance of country roads. This year the legislature has provided that where a systematic plan is adopted by a county they will contribute 20 per cent. of the cost, which is one half what they pay toward construction.

The maintenance of a highway is admittedly more important than construction or re-construction, consequently were the larger percentage paid for maintenance and the smaller for construction or had they been placed on equal basis we would conclude due consideration had been given the matter before the final decision was made and a premium placed upon the neglect of the more important phase of the work.

Where traffic exceeds 250 to 400 vehicles per day and consists in part of auto trucks, a gravel road will not maintain its binder and must be replaced by a better class of road. Where such conditions have developed there is no hesitation upon the part of the County Council to assume the responsibility and construct the new and more expensive road.

The ease with which such men adapt themselves to the changed conditions and decide on the large expenditures necessary to finance the change is accounted for by the fact that they have through the construction of the lighter class of road and its maintenance become accustomed to the expenditure of comparatively large sums of money and this has served as an education to train them for the larger expenditure. This is in marked contrast to the people living on the earth road who have been inactive and their inactivity has not only left him without education along such lines but has created a condition within themselves which they are incapable of overcoming. When told by an outsider or by one of their companions who has remained normal under such conditions how they may receive and finance a scheme to bring them out of their difficulty, they will not believe, or if they do, they sicken at the thought of the expense like a young child who has received an overdose of pap. They realize their weakness and express a desire for strength. If they take their nourishment in increasing quantities they will soon be able for a full meal of solid food in the form of gravel stone or concrete. Their first dose must necessarily be a County road Bylaw.

Gravel roads are profitable so long as they satisfy the demands of the people who use them and can be maintained for less than the interest on the cost of a new and better class of highway.

When is Crushed Stone Profitable?

By Lucius E. Allen, C. E.*

THE subject, "When is Stone Profitable for Roads," which I have been asked to speak upon this morning is one which if thoroughly treated in detail would require considerable time, and in the time allotted for introducing this subject for discussion, I can only outline some of the more important points with reference to the use of stone as a material for road construction.

The use of stone for the construction of ordinary highways is of ancient origin, the remains of stone metaled roads having been found in Egypt dating from the time of the Pharaohs. The Carthaginians also used stones bound with sand, and the so-called Roman roads were mostly built of stone laid in various ways, but probably the modern methods of using broken stone and afterwards consolidating by natural or artificial means dates from the time of those forefathers of Good Roads McAdam and Telford in England, and Tresaguet and Polonceau in France.

The systems of road construction as designed and introduced by Tresaguet and McAdam differed only in the matter of the foundation. The system as introduced by Tresaguet consisted of a stone foundation six to eight inches in depth formed up of stone blocks laid on a bed whose surface was given the same camber as the finished roadway. These stone blocks were placed by hand and the crevices filled with stone chips well hammered in. Upon this stone foundation a layer of crushed stone was placed of from four to six inches in depth and thoroughly rolled, or consolidated. In modern practice the surface metaling is usually put down in two layers, each layer being well rolled, with the addition of fine screenings to act as a binder. This type of roadway, while being rather expensive in first cost, if properly constructed has been found to be a very durable type of roadway and well adapted for certain localities.

On account of the heavy built up stone foundation which takes up the impact and shock upon the metal surface from heavy traffic, this type of roadway is consequently well adapted for roads where the character of the traffic consists of heavy moving loads such as trucks, tractors, etc. The metal wearing surface when worn down can be renewed many times without extra labor or material being expended on the stone foundation.

McAdam's system is essentially the same as the French system except that the stone foundation is omitted, the roadway consisting of a more or less dense layer of metal of varying sizes held together by a binder of fine material and well rolled. Polonceau, a French engineer, in 1829 improved upon McAdam's system of construction by first making use of road rollers to compact and consolidate the metaled surface.

Undoubtedly the macadamized road where the natural sub-soil is good is the most economical type, as the wear on a roadway is largely on the surface, and as long as the metal surface is kept in good repair there is no necessity for an expensive stone foundation similar to the original French system. Where good gravel is difficult to obtain and a suitable crushed rock is available, a road surface composed of from four to eight inches of crushed stone, placed on the old gravel or earth roadway, after scarifying same, and well rolled down with a road roller is for our ordinary highways the best type of roadway, provided they are properly constructed and the best material used.

While a roadway constructed in this manner may be adapted for districts where the traffic conditions are not too excessive, it is no doubt advisable where the conditions are favorable and warrant a more permanent road surface to adopt some form of bituminous binder or carpet which will bind the stone aggregate into a more or less solid mass that will withstand the hammering action of heavy traffic.

Where the motor traffic is considerable—and few of our main highways are not now extensively made use of by motor cars—a treatment with road oil on the surface will greatly increase the durability of the roadway, and decrease the dust nuisance.

It is not, however, within the scope of this paper to enter into a discussion of tar or bituminous bound macadam, or carpeted stone roadways, or oil treated roads, but rather to refer to several points which

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should be, and many times are not, carefully considered in selecting stone for roads.

Quality and Kinds of Stone Adapted for Roads

Too little attention is often given to an examination of the kind and quality of the stone which is to be placed on our roads. There are many instances where a crushed rock has been carelessly selected and used, which in the end proved to be far inferior to a good gravel. Within the Province of Ontario occur a great variety of igneous, sedimentary and metamorphic rocks some of which make excellent material for road metal, while others which may appear firm and hard superficially soon weather or rapidly deteriorate under traffic.

Within the past few years many of the Highway Departments of the principal countries in Europe and in America have realized the importance of a systematic examination of those rocks best adapted for road construction, by establishing testing laboratories for this purpose.

To France must be given the credit for first establishing in 1878 a laboratory for testing road materials. Colonel Crompton, Consulting Engineer to the British Road Board, established a few years ago at Teddington, England, an excellent testing laboratory for determining the relative value of various road building materials and designed and put in operation a machine which subjects various types of roads and pavements to the actual conditions found in all classes of highway traffic, and most valuable information has been secured from the results of his work.

The Provincial Department of Highways of Ontario, under the efficient direction of Mr. McLean, is also equipped to carry out the testing of rocks for road building.

In addition to a chemical analysis of a rock, which in many cases will indicate its suitability, there are four essential physical tests which should always be applied in determining the relative suitability of the rock. These tests when applied will show:—(1) The relative hardness; (2) Toughness; (3) Abrasiveness, or resistance to wear; (4) Cementing value.

It is obvious that a rock which best withstands the destructive agencies of the atmosphere, water and the severe wear and tear of traffic is under normal conditions the most economical to use, and in many cases it will be found that the use of a rock which happens to be in close proximity to the work, and therefore costing much less for haulage or transportation, may yet be far less economical than a rock found many miles distant.

A determination of the hardness of a rock will indicate its ability to withstand the displacement of its surface particles by the friction caused by steel tyred vehicles.

The relative ability of a rock to resist fracture from the hammering action of rapidly moving vehicles is a measure of its toughness.

The abrasion test will show the relative degree which a rock will withstand wear, or the grinding action of the steel tyres and the steel caulks of horses' shoes.

The relative degree to which a rock dust will cement or hold the rock particles together, thereby forming an impervious and smooth road surface, is its cementing value.

Just as a poorly burned or porous clay brick will absorb a large amount of water, thereby tending to disintegrate the brick structure, so a soft and porous rock will tend to disintegrate under the continual action of water and frost.

As a general rule the granites are much harder than the limestones, but on the other hand have much less cementing value. There is no doubt that for toughness and ability to withstand severe wear the trap rocks are the best for road making material, however on account of the excessive first cost of trap rock in many localities the use of crushed granite, field stone and limestone prove to be the most economical in practice.

As a general principle it may therefore be stated that a rock that combines to the highest degree the properties above referred to is the best adapted for road construction. The following record of a large number of rocks tested by the United States Bureau of Roads will serve to show the comparative values of the various rocks used for road construction.

Table

Showing the average results of all of the tests conducted on characteristic road building rocks up to Jan. 1, 1912, as carried out by the U. S. Department of Roads.

	Hardness	Toughness	Cementing Value	Per. cent of Wear
Limestone	14.4	8	54	5.2
Sandstone	15.0	12	62	5.7
Granite	18.5	12	18	4.5
Trap Rocks. . .	17.6	17.4	95.4	3.1

Construction and Maintenance

The first essential in the construction of a stone roadway is to provide proper drainage. It is obvious that if water is allowed to soak into and penetrate the soil foundation of the roadway, the road crust will soon be disrupted, the result being that the lower portion of the stone crust penetrates into the wet soil and gradually the soil becomes mixed with the stone, causing holes and eventually almost complete destruction to the original roadway. Good drainage can be secured by keeping the earth shoulders well down, and providing side ditches of sufficient depth and width to quickly remove the water.

Many times the lack of suitable culverts to carry the water from a higher to a lower level underneath the roadway is the cause of serious destruction to the road. In soft and boggy soil it is necessary in some cases to construct lateral drains, leading from the center of the roadway to the side ditches. Proper and ample road drainage is just as essential as farm drainage and the initial cost will soon be repaid in the increased life of the roadway.

Grades and Crown

As the ordinary constructed roadway surface is not impervious to water proper crown should be given to the road to prevent water settling on the road crust. Ordinarily a crown of one-half to three-quarters of an inch per foot is sufficient for macadam roads.

In the construction or reconstruction of so-called main trunk roads reduction of excessive grades is also important. The increased hauling power of heavy loaded vehicles due to decreased grades on highways will in many instances soon repay the initial cost of the reduction of the grade.

Too much care cannot be exercised in rolling. It should commence at the edge and work towards the center, the roller at all times traveling parallel to the center line of the roadway. With proper rolling the consolidation of the crushed stone surfacing should be equal to about 33 1-3 per cent. of the loosely deposited stone.

The size of crushed stone best adapted for road metal depends upon the type of road under construction. Usually larger size stone up to three inches may be used in the bottom or foundation course, and the finer stone for the top courses. The aggregate should be so graded as to furnish sufficient sizes to consolidate into a typical mosaic under compression. Sufficient fine stone screenings should be used on the finished road surface and watered to thoroughly seal and fill the voids in the compacted metal.

The question of maintaining our stone roads is of almost greater importance than new construction work. Much thought and attention has been given the matter of how best to keep our roads up to a high state of repair. The use of narrow tyred heavy vehicles should at once be prohibited. The cutting action upon the metal road surface of such a vehicle passing over a roadway during wet weather is one of the most destructive agencies to roads. Once a rut is formed, water immediately collects in the rut and penetrates transversely throughout the road surface, thereby hastening the disintegration of the road surface.

Two general methods of maintenance are followed in various countries, namely the "Patchwork System" and the "Periodic Renewal System."

It is truly said that maintenance should start as soon as a roadway is completed. The "Patchwork System" as generally carried out involves the constant and immediate repair of any portion of a stone roadway as faulty spots develop. It can be carried out by a system of patrols, who become responsible for a given length of road section. The work of repairing and filling holes and bad ruts should be done by men familiar with and experienced in the work. The old adage "A stitch in time saves nine" aptly applies to road repair work. In the patrol repair system suitable quantities of crushed stone should be kept at intervals on each road section. One man and a horse and cart can keep in repair a considerable length of roadway. As to whether such a system of road maintenance would work out to the best advantage in this country is not within the scope of this paper.

The "Periodic Renewal System" is based on the principle of a general resurfacing of a given roadway as soon as it becomes badly worn. The disadvantage of the system is that it requires a much larger amount of material to complete the resurfacing of an entire roadway. The unit cost of carrying out the work is no doubt less than in the "Patchwork System" as materials can be handled on a larger scale and the work is concentrated at one point.

It would appear that possibly a combination of these two systems could be worked out to better advantage in this country than either the one or the other.

As much depends on the amount and character of the traffic over a given highway as to the amount and depth of road metal and foundation that should be used, it is essential that a careful census be taken extending over a considerable length of time. As traffic, especially automobile traffic, will seek the best road, it is necessary to make due allowance for the probable area from which new traffic will originate.

Conclusions

In concluding the introduction of the subject of crushed stone for roads, it may be stated that no hard and fast rule can be laid down as to when stone can be used for road construction in general, neither can any fixed figure be given for the cost of a macadam roadway, as the cost of labor and materials will vary greatly in different localities. It may be stated, however, that in districts where suitable stone adapted for road metal is found, it is generally preferred to other material such as ordinary untreated bank gravel.

The uniformity of crushed stone as compared to natural gravel is no doubt an advantage, as bank gravel has been laid down in strata the result of glacial drift or sedimentation and it is difficult to always obtain sufficient uniformity to ensure the necessary binding and wearing properties for road construction.

The salient points to be considered in the construction or re-surfacing of a rock metaled roadway are:—

1. Careful examination and selection of the quality of the rock, taking into consideration the relative durability and initial cost.
2. The proper preparation or scarifying of the foundation.
3. The drainage of the foundation by means of ditches, drains or culverts and the removal of the earth shoulders to secure surface drainage.
4. Consideration before construction is started of the estimated amount and character of the traffic, upon which the type of construction can best be determined to meet existing or future traffic conditions.
5. Due attention to the grade and crown of the roadway to ensure uniform wear over the traveled portion of the roadway.
6. After construction is completed the immediate and constant attention to repair and maintenance, which will add to the ultimate life of the highway.

In many sections of Ontario it will be many years before the density and wealth of the population will be such as to warrant the construction of so-called permanent highways, and the use of the cheapest and most abundant natural road material such as gravel and stone will have to be resorted to, so that the methods of constructing stone metaled highways will continue to be of greater importance to a larger number of people than the construction of more expensive highways.

It is quite possible that as these materials and methods are further investigated the present methods will be so improved upon that for a majority of our roads, the use of crushed stone will continue to be the predominant road building material.

When is Bituminous Material Profitable?

Mr. E. A. James, County Engineer for York, states that in some parts of York County the country roads, as far as traffic goes, are regular city streets; on some roads as high as 200 vehicles per hour and 12 trucks from 12 to 16 tons, pass per hour. Under such conditions brick laid on 4½ in. concrete foundation, 18 ft. wide, with stone shoulders on an old 24 in. stone foundation, has proved the most satisfactory. This road in 1911 cost $22,000 a mile and, after four years wear, has only cost $2.00 to $3.00 per mile maintenance. Rocmac pavement, a preparation of silica, with limestone dust, forming an insoluble chemical compound, has been used to good advantage on some roads in York county, giving much better service than water bound macadam.

In 1913 the county of York commenced building with bituminous pavement on old macadam roads, which had about 9 in. of stone foundation. The old macadam was first thoroughly cleaned with a rotary brush, picked and swept and a four inch layer of 2 in. limestone laid and consolidated. 1¼ to 1½ gals. of bitumen per sq. yd. was then sprayed on by pressure tank and any excess taken up by stone chips, after which the whole surface was consolidated to 3 in. in depth. ½ to 1 gal. of bitumen per sq. yd. was then applied and the surface sanded and rolled again. The average cost in 1913 and 1914 was 62c per sq. yd.; stone costing $1.05 per ton, labor 20c an hour and teams 45c per hour. On old gravel roads of 4 in. to 9 in. thickness, which are being subjected to increased traffic, it is considered unwise to resurface with gravel, but rather to reshape the road with a 5 in. coat of 1¼ to 1½ in. stone with some tarvia, similar to a water bound macadam construction. This costs about 85c to $1.00 per sq. yd. On grades over 7 per cent. it is found extremely difficult for heavy traffic to pass up on bituminous surfaces, without sanding. Brick is passable up to 8 per cent. grade without sanding. The advantages of these surfaces is the elimination of dust—present in water bound macadam roads. The apparatus needed in the penetration method is very simple and very cheap. In the mixed method, of mixing the material and the bitumen, then placing, the apparatus is more expensive, but the type of road is also superior to that built by the penetration method. The cost for the latter method is about ten per cent. in advance of the penetration method. Mr. James, in replying to the questions of bridges rutting and the effect of frost in spring on surfaced roads on clay soils, said that he had found a mixture of bitumen with ¾ in. stone thoroughly compacted in the road rut to give thorough satisfaction. Improved roads have always been well drained and being waterproof have kept dry and have given no trouble.

When is Concrete Profitable

Mr. H. S. Van Scoyoc, chief engineer of the Toronto-Hamilton Highway, addressed the convention on "When are Concrete Roads Most Profitable?" Mr. Van Scoyoc spoke of the various items to be carefully considered and properly balanced in deciding upon any particular type of surfacing for any locality. While improved roads create values that cannot be measured in dollars and cents, the commercial standard is the one most readily set up. Mr. Van Scoyoc spoke of the cost of different types of highways, and common factors of cost in different types. He also gave specific examples of roads of different widths in township, county and suburban road construction and the proportion of cost to be borne by the province, county, city, or municipality. Also a few words on depreciation and maintenance of different types of roads. Mr. Van Scoyoc's paper will be printed in full in an early issue of the Contract Record.

The Importance of Road Maintenance

By Major J. M. Sheppard*

THE problem of maintaining the 42,000 miles of highways in the Province of Ontario will for all time to come, tax the energy and resources of the Road Engineer and call for an increasing and continuous expenditure.

When we realize that from one and a half to two millions of dollars in cash is expended annually by the Townships, and that an equal amount or more is worked out in a more or less useful way by Statute Labor, we begin to realize that it is time that a more practical and intelligent system of Road Maintenance should be inaugurated. Present conditions which are bound to increase and become exacting, demand something more efficient than Statute Labor, or the haphazard work that has tided us over in the past.

In addition to the large sum above mentioned, there has been expended since 1902 approximately $5,000,000 on different County Road Systems, the annual expenditure being now about $800,000. As it is the province of the County Road System to build roads that will be a stimulus and example to the Townships, so it must be the duty of the Counties to so maintain and care for the County Roads, that the townships whose roads are the feeders of the system, will build and maintain their roads in a like manner.

In most of the counties we are still in the constructive period and no doubt, further large sums will be expended on construction in the near future, but we must not forget in our enthusiasm for new roads, that the $5,000,000 already expended must be protected and the only way this can be accomplished is to carefully maintain the roads already built. To do this, it has been found in every case that some plan of permanent and continuous patrol must be organized.

Circumstances must, of course, determine what is necessary but the principle that someone is in charge of the road and responsible for its maintenance and that suitable material and tools are always available, so that repairs can be promptly made and damage and accidents avoided, must be kept in mind.

In some cases on the roads where the traffic is heavy and continuous, it is necessary to at once divide the highways into suitable divisions and employ permanent men to take charge. In other cases, men might be engaged and paid for the time actually employed. No matter which plan may be adopted, something must be done to preserve the original condition of the roads, following construction. The general public have too much interest and the taxpayers too much money invested to allow the roads to get into such a condition that they would have to be rebuilt in a few years.

A few of the main features of Highway Maintenance are noted as follows:

Drainage

As drainage is the first principle of construction, so it is the first to consider in maintenance. All side ditches culverts and outlets should be kept free from obstructions at all times, ice and snow removed when needed, and if possible underdrains laid where the road seems to have a tendency to heave; outside the metal or gravel kept smooth and shoulders thrown outside the ditch or removed so the water can flow to the side ditches and not sink into the road.

Weeds, brush and other obstruction of that kind ought to be kept down; not alone is it against the law

* Road Superintendent, Welland County.

to allow noxious weeds to grow on the highways, but weeds, grass and other objectionable matter growing on the side of the road give it an untidy appearance and hold snow and water and prevent quick drying. Too many trees also keeps the road wet, a heavy row of trees especially on the south side prevents the sun drying out the road. An effort should be made to have part of them removed or have them well trimmed up.

Hills

Hills require constant attention; the crown must be kept higher than on level stretches, as the water will follow the wheel tracks and wash out ruts. Side slopes also require to be watched to prevent slides filling up the ditches and turning the water into the road bed.

Culverts

Culverts also need care to prevent floating material from obstructing the openings; brush leaves, grass, etc., form dams which prevent the water passing through freely. When freezing follows the pressure of the ice cracks or breaks the tile or side walls and damage follows, which a few minutes attention would have prevented.

Guard Rails

Another matter that often needs attention is the guard rails which protect approaches to bridges and other dangerous places. Nothing looks worse than old broken and out-of-line rails that have been allowed to get out of repair, not alone the neglected appearance but the danger to the municipalities from their liability in case of accident. We know from experience that every one that goes on the highway is insured and the only way the public can be protected is to have all bridges, culverts and other dangerous places fool proof.

Finally

We must provide for an ever-increasing and continuous-wearing traffic. Ten years ago, it was a curiosity to meet a motor car, now on many roads it is just as rare to meet a horse-drawn vehicle, except it be a team doing farm work. The radius of travel is increased four-fold, before the era of the motor car ten miles was considered quite a journey to go and return in an afternoon, now forty miles is only a little spin. A few years ago, a farmer passed along his team making 3 miles an hour drawing fifty bushels of wheat weighing 1½ tons. Now the motor truck rushes past carrying four or five tons at a speed of 15 miles an hour. All these changes may make for the business and pleasure of the community, but they provide many problems for the future Road Builder.

Report of Committees

The committee on resolutions reported the following and recommended their adoption:—

1. That the Minister of Highways be requested to consider the advisability of making provision for supplying road building material at a minimum of cost.—Carried.

2. That we approve of the action of the Legislature in increasing their contribution towards the construction of county roads and by making provision for maintenance and express the hope that additional assistance will be granted when the provincial revenues warrant it.—Carried.

3. That we approve of the Bill to regulate the load of vehicles operated on highways, with the addition of a clause, authorizing municipalities to place notices on bridges already constructed specifying the load that they will carry, and that this notice be operative to protect municipalities for ten years or until a bridge is strengthened to carry the weight specified in the Bill.—Carried.

4. That the Highways department be requested to consider the advisability of supplying standard bridges to counties working under the Highway Improvement Act.—Lost.

5. That the section of the Municipal Act providing for the approval of County Bridge plans by the Provincial Highways department be extended to include the plans of bridges of 25 ft. or over in townships.—Carried.

6. That a uniform system of accounting for highway improvement should be considered by the Department of Highways, so that information showing the comparative cost of highways in the various counties receiving aid from the Province will be available.—Carried.

7. That the Good Roads Association arrange with the Department of Highways for a campaign of education in all countries that have not adopted a country road system under the provisions.—Carried.

8. That the Minister of Highways be requested to complete the construction of sample roads in the counties that have not adopted a county road system.—Lost.

9.—That the executive of the Good Roads Association be requested to continue their efforts to obtain lower freight rates for all road building material used by municipalities: and other matters pertaining thereto.—Carried.

10. That the secretary of this association convey to Major T. L. Kennedy, past president who is now on the firing line in France, their pride and satisfaction in knowing that one so long associated with the Good Roads movement in Ontario, is now upholding the honor of his country in its day of trial and express our sincere hope that he may live to return to us in victory, and that we may again have the pleasure of his presence among us and his sympathy and advice in the cause he has so much at heart.—Carried.

11. The Minister of Highways be requested to consider the advisability of amending the Highway Improvement Act by providing for the assessment of lands adjoining and contiguous to county roads, for benefit derived from the construction of said roads.—Carried.

Mr. G. S. Henry brought in the treasurer's report, which was accepted.

New Officers

Mr. J. A. Sanderson, past president, chairman of the nominating committee, presented the following list of new officers which was accepted: Honorary Presidents, N. Vermilyea, Belleville, and J. A. Sanderson, Oxford station; Pres. S. L. Squire, Watford; First Vice-President, C. R. Wheelock, Orangeville; Second Vice-President, J. J. Parsons, Haldimand; Secretary-Treasurer, George S. Henry, M.P.P.; Directors; W. H. Pugsley, York; Major Kennedy, Peel; L. E. Allen, Hastings; F. A. Senecal, Prescott; David Clow, Leeds, and K. W. McKay, St. Thomas.

Mr. A. T. Laing, secretary of the School of Science, Toronto, spoke of the road-builder as being almost as great a factor in the building of the Empire as the soldier in the trenches. Mr. Laing also spoke on the system of accounting in the counties under the Highway Improvement Act, and looks to see the time when people will see the advantages of a Good Roads system over and above the financial considerations.

Mr. George Hogarth, chief engineer of Highways, commented on the enthusiasm and interest shown in the convention, and extended an invitation from the Highways Department to the delegates present to consult them on any matters whatsoever in regard to highway improvement, at any time.

Major Kennedy, Past President of the Ontario Good Roads Association, who is now somewhere in Belgium, in a letter to the Secretary, Mr. Geo. S. Henry, M. P. P., described some of the roads over which he has passed on the way to the firing line.

The Raymond Concrete Pile Company, Limited, have been awarded the contract for the foundations and new additions to the Belgo-Canadian Pulp and Paper Company, Limited, plant at Shawinigan Falls, P. Q.

Aggregates for Concrete Roads

Important advances made in the knowledge of concrete aggregate which compose 80% of material in a concrete road—Life of concrete roads depends on the durability, grading, cleanness and chemical composition of the aggregates

By D. A. Abrams*

A permanent road must be designed and built to withstand three different destructive agencies; namely, traffic, weather, and structural stresses. All of these agencies must be adequately provided for. It is generally impossible to distinguish between the effects of traffic and weather; the combined effect of these two agencies requires the most careful consideration on the part of the road builder. Assuming that weather resistance and structural stresses have been properly considered in the selection of the type of road to be built, and in the design and methods of construction to be used, the total effect of all other desirable qualities of a permanent road may be expressed as its wearing resistance.

The wearing resistance of a concrete road subjected to given conditions of traffic and weather will depend upon the following factors, named in the order in which they are encountered: The properties of the concrete materials; proportions and consistency of mix; thoroughness of mixing; method of placing; surface finish; conditions of seasoning; and age of the concrete.

The wearing surface of a concrete road is subjected to a most severe usage. The aggregates constitute 75 to 85 per cent. of the material in a concrete road; hence the resistance to weather and traffic, and the final integrity of the structure, depend largely on the properties of the aggregates. Aggregates of the highest quality are essential. It is the function of this committee to report on the present state of our knowledge of concrete aggregates.

Properties of Concrete Aggregates

Important advances have been made in our knowledge of concrete aggregates and in the practices governing the selection and use of these materials since the adjournment of the First National Conference on Concrete Road Building. The carefully compiled specifications for aggregates formulated by that Conference and other bodies have been widely adopted and used with results which have been most beneficial. Greater care in the selecting and testing of aggregates has been a characteristic feature of recent practice in concrete road construction.

Experience has shown that, other factors being equal, the life of a concrete road depends on the following qualities of the aggregates:

Durability of particles. (Toughness, strength, hardness, brittleness, density, resistance to weather, impact, abrasion, etc.)

Grading. (Size and shape of particles, amount of voids, etc.)

Cleanness. (Amount and character of impurities.)

Miscellaneous properties. (Chemical and mineralogical composition, structure, etc.)

These properties are named in the order of their importance for usual conditions.

All tests of concrete aggregates are made for the purpose of classifying the materials with reference to one or more of these qualities. Since wearing resistance is an important property of concrete for road building, we are principally interested in those qualities of aggregates which combine to produce a concrete of high resistance to wear.

Testing Concrete Aggregates

All tests of structural materials are made for the purpose of enabling the constructor to learn in advance of use whether the material is suitable for the purpose and to determine the relative utility of different available materials. The knowledge gained from the experimental studies of aggregates has not kept pace with the demands of construction. Most of our knowledge of the requirements for aggregates for use in concrete roads has been derived from observation of the behavior of the materials in service.

Due largely to the recognition of the necessity for careful scrutiny of the materials which are proposed for use in concrete roads, a wide-spread interest has arisen during the past few months in the study of aggregates and the tests which may be expected to indicate their suitability for this and other service. Aggregate testing as practised at the present time is of recent origin, hence standard methods for conducting many of the tests have not been developed. Several of the leading engineering societies now have technical committees which are actively engaged in studying these problems. The testing of concrete aggregates is receiving more attention at the present time than ever before. It seems probable that these materials are now the subject of a larger number of experimental studies than any other group of engineering materials. Many of the materials testing laboratories are carrying out researches which will prove of the utmost value in arriving at a rational basis for proper specification requirements and tests.

It may be expected that long experience would indicate the relative merits of different materials and methods of constructing concrete roads. It is the function of careful tests and experimental researches to replace evolution and accomplish the desired results without the costly errors and delays which generally result, if the lessons of experience in service are to be our only guide. The tests of service will, of course, continue to be the court of last resort in determining the fitness of a material and the value of methods of construction, as well as to furnish a guide to proper laboratory tests.

Aggregate Tests

Tests of concrete aggregates may be made on the materials as delivered for use, or on mortars and concretes made from the materials.

Concrete is a manufactured product which results from mixing cement, water and suitable inert materials in the proper proportions and allowing the mass to season under favorable conditions. Recent advances in materials testing show the advantages of testing the finished product or the completed structure, rather than attempting to determine the quality of the pro-

*Chairman of Committee on Concrete Aggregates, before National Conference on Concrete Road Building, Chicago.

duct solely from information gained by a study of the component materials.

The wearing resistance of concrete is its most important characteristic for use in roads. Wear on a road surface is due to the combined action of stresses such as impact, abrasion, crushing, etc. Experience shows that concrete which will withstand street traffic will give a good account of itself in other respects. These considerations suggest a wear test of concrete as the most direct method for studying the relative merits of different materials and methods. Experimental work of this kind is in progress in several laboratories.

The Talbot-Jones Rattler, which was originally designed for tests of paving brick, has been used for exposing the concrete surface to the tumbling action of a heavy charge of iron shot or blocks. This test is the most promising which has come to the attention of the committee. The Deval Abrasion Testing Machine has also been used for tests on small mortar speciments. These methods of testing have not been studied sufficiently to fully establish standard methods and to indicate the exact relation between the indications of the tests and the behavior of similar concrete in service. The data now available on wear tests of concrete do not justify the attempt to formulate specification requirements for aggregates on the basis of such tests.

In the absence of a satisfactory wear test of concrete, we must continue to depend upon the tests of materials and concrete which have been shown to be significant in furnishing information on the quality of the aggregates.

On account of the great economies which result from utilizing materials that are readily available, and the absence of well-developed sources of supply in many localities, it is of prime importance that all aggregate materials for concrete roads be tested before use. All engineers of wide experience in concrete road building agree as to the importance of careful selection of aggregates.

In the following discussion only the more important tests are mentioned. A complete discussion is not attempted.

Under the heading "Durability," a number of the fundamental physical properties of aggregates have been grouped. It is difficult to discriminate between the effect of toughness, strength, hardness, brittleness, and resistance to weather, impact, abrasion, etc., in aggregates. It has not generally been considered necessary to make tests for the purpose of determining the effect of each of these properties. However, even though no tests are made, we must consciously or unconsciously weigh and pass judgment on all these factors before we can reach a conclusion as to the suitability of a given aggregate for use in concrete roads.

No satisfactory method of measuring the hardness of an aggregate is available. The exact influence of different degrees of hardness of the aggregates on the wearing resistance of concrete has not been determined. However, it would seem that the hardness of the aggregate should be well in excess of that of the cement itself after it has thoroughly set and seasoned, to the end that the impact and abrasion of traffic may be fully resisted. Uniformity in the qualities of an aggregate is of the utmost importance.

A direct determination of the compressive strength of an aggregate is seldom necessary, since the ultimate value of a material for concrete road building generally depends on other factors.

Certain tests for determining the toughness, abrasive resistance, etc., of crushed rocks have been used. These tests were introduced in this country by the United States Office of Public Roads. They have heretofore been carried out with particular reference to determining the suitability of rocks for use in macadam road construction. It is not clear now just what relation the evidence of these tests has to the suitability of a crushed rock for use as a concrete aggregate. Some of the tests which generally have been made cannot readily be applied to material of the size used for aggregates; none of them is applicable to natural sands and gravels. Modified forms of the standard abrasion test with the Deval Abrasion Testing Machine have been used by some engineers as a basis for specification requirements for concrete aggregates. In these tests charges of cast iron or steel shot have been placed in the test chamber with the aggregate sample. The proportion of material reduced below a given size is taken as a measure of the abrasive resistance of the aggregate. This form of test deserves further study. There is a great need for a simple standard test which will serve to distinguish between aggregates which are too soft or too brittle for use in concrete roads, and those which may be expected to give satisfactory results.

Weather resistance is an important property of materials which are to be used in the wearing surface of concrete roads. A laboratory test which will furnish a reliable guide to the weather resistance of rocks under different climatic conditions has not been discovered, although many tests have been proposed and used. Alternate freezing and thawing, acids and disrupting agencies represent the most commonly used tests for this purpose.

The appearance of natural sands and gravels and a consideration of their origin and geological history will frequently furnish an indication of their probable resistance to weather. The examination of portions of the same stratum which has been exposed to the weather for several years will generally furnish a satisfactory criterion of the weather resistance of a crushed rock.

Grading

The division of aggregates into fine and coarse is an arbitrary one. The distinction arose, no doubt, from the practice of securing the fine and coarse materials from different sources, and has been preserved largely for convenience in proportioning. It is almost universally customary to consider particles smaller than ¼ inch as fine aggregate and larger material as coarse aggregate.

Experience in the use and testing of concrete has shown that with a given proportion of cement, wide variation in the quality of the concrete results from differences in the grading of the aggregates.

A study of tests of sands and sand mortars indicates that the grading of the material, or the relative proportions of the particles of different sizes, is one of the most important factors which influence the mortar-making qualities of natural sands. All tests emphasize the advantage of using sands in which the coarse particles predominate and the fine are reduced to a minimum. A coarse, well-graded sand gives low voids, hence correspondingly high strength and improved wearing qualities. The so-called straight-line grading of sand conforms closely to that giving the highest strength in mortar tests. However, a certain degree of "workability" is essential; hence a larger proportion of fine sand than that indicated by the straight-line grading is generally desirable and is nearly always found in natural sands.

It seems probable that a more thorough study of the effect of grading of sands will demonstrate economies which may be effected by more accurate grading, and make it desirable to specify the required grading within narrower limits than is now customary. It is frequently found that a high-grade, fine aggregate can be produced by combining in the proper proportions two lots of material, neither of which is satisfactory for concrete roads if used alone. The mixing of fine sand with a coarse sand or screenings from crushed rock of good quality is sometimes an economical procedure.

It seems probable that the grading of coarse aggregates exerts an important influence, although the relative variation in grading is generally much less than in natural sands.

The earlier builders of concrete roads used coarse aggregate graded from about ¼ to 1 or 1¼ inches. It has long been recognized that concrete of greater density and strength can be produced by using coarser material. A saving in the cost of crushing can be effected by using aggregates as coarse as the nature of the work will permit. With the richer mixes that are now common in concrete road construction no difficulty is encountered in placing and finishing roads with aggregates graded up to 2 inches. It is believed that this size of material will produce a superior concrete for use in a one-course road. In two-course construction or where required by local conditions of supply, finer material may be used.

In certain instances it may be desirable to consider fine aggregate as material graded up to ⅛ inch instead of ¼ inch. In this case corresponding changes must be made in the specification requirements for the grading of aggregates and in the proportions used. The use of fine aggregate graded up to ¼ inch is recommended.

Owing to the wide variations in practice in screening coarse aggregates, it does not seem feasible to specify the sizes to be required, within too narrow limits.

There is great need for a standardization of sieve sizes and of the methods of conducting sieve tests both of fine and coarse aggregates.

The voids in aggregates are largely a function of the shape and grading of the particles. Low voids should be secured, since the strength and "workability" of the concrete will thus be greatly improved. A well-graded natural sand will show voids as low as 28 per cent.; in a poorly graded sand the value may be as high as 38 per cent. The voids in crushed stone frequently run to 50 per cent.

Cleanness

The impurities in aggregates generally consist of clay or loam. The presence of a small percentage of clay in a loose, finely divided condition is not usually found to be harmful. Clay which coats the particles is likely to prove injurious. A large percentage of clay in sands or gravels suggests the presence of clay pebbles. The presence of vegetable loam or other organic materials always has a deleterious effect. Mica in sand reduces the strength of the mortar. The possibility of the presence of other impurities should not be disregarded.

The term "silt" is used to designate all foreign material which may be present in an aggregate in the form of a coating on the grains or in a finely divided state, or which is of a soft or soluble nature. It is in tests of natural sands that a study of the silt is most important. Various methods of determining the amount and nature of the silt are in use.

Washing a given weight of sand in a glass percolator with running water under a constant head until the wash water becomes clear, and determining the amount of silt on the basis of the loss of weight, seems to be the most accurate and scientific method for laboratory use. For a discussion of another method, see Appendix A, on "Field Inspection of Aggregates." A chemical analysis of the silt frequently indicates the presence of injurious materials. The strength test of mortars and concretes generally furnishes a safe criterion of the effect of such impurities as are contained in the silt.

Miscellaneous Tests

The exact bearing of the chemical and mineralogical composition of an aggregate on its suitability for use in concrete roads has not been definitely established. In so far as variation in these properties affects the toughness, resistance to weather, wear, etc., they will influence the final value of the material. The form of fracture, and the nature of the surface of the particles, have an important bearing on the road-making quality of aggregates.

Tests of Mortars and Concretes

A discussion of the properties of concrete aggregates must of necessity deal largely with tests of mortars and concretes. A wear test of concrete, standardized with reference to the behavior of concrete in service, would furnish the most direct indication of the value of different aggregates for concrete road construction. Such a test would be of assistance in studying the effect of other variables such as the proportioning, mixing, and seasoning of the concrete.

A suitable strength test of a mortar or concrete made up from cement and the aggregates in question is without doubt the most reliable single determination which can be made in view of our present knowledge. This test gives information as to whether or not the aggregate affects the setting and hardening of the cement—a consideration of prime importance. It also indicates what may be expected from the standpoint of strength. If the form of test specimen, proportions, method of mixing, seasoning, etc., are standardized or are made to approximate those used in the work, an excellent indication can be secured of the probable strength of the concrete in the structure. It is apparent that tests of concrete furnish the best criterion of the concrete-making quality of either a fine or a coarse aggregate.

(Continued in next issue.)

Damage to Sooke Lake Waterworks

Twelve lengths of pipe were swept away and considerable water wasted owing to a break in the concrete flow line of the Sooke Lake waterworks system Jan. 22. This is the first accident which has occurred to the line. It was caused by a landslide. The damage is slight, it is reported, and until repairs can be made a temporary wooden trestle bearing a wooden flume will be used. The water stored in the Humpback reservoir is reported to be more than sufficient to supply the city while repairs are being made.

Developing the Export Trade of the Dominion

A special luncheon of the Canadian Manufacturers' Association was held on February 23rd at which the members were given an opportunity of hearing an address by Mr. F. C. Armstrong, European manager of the Export Association of Canada, Limited. Mr. Armstrong is on a brief visit to Canada, after making a careful study of the general business situation in England and France. While abroad he had exceptional opportunities for obtaining reliable information regarding the fiscal policies likely to be adopted by the allies in the near future. Mr. Armstrong said that he had gone to England to look over the situation there and on the continent, in behalf of the Export Association of Canada. He had now returned to report upon the position as he found it, and to consult with the directors and shareholders of the Association as to future steps.

The speaker stated that the subject of export trade was of the most vital importance to every Canadian. Next to the winning of the war the most important thing for Canada and for all the allies was to organize their manufacturing industries, transportation facilities, etc., so thoroughly that after the war the prosperity of the country would go on without interruption. When one spoke of "after the war" there had formerly been a great deal of misunderstanding as to just what war meant. During his visit to England and France he had realized that a great unanimity of opinion was developing as to what this term involved. The people of the allied countries had come to realize that they could not be satisfied with winning the war, but must rid the world of German aggression after defeating Germany's army in the field. If they allowed Germany, after the war, to build up her commerce and wealth, they would be giving her power once more to forge another weapon with which to renew her scourge upon civilization. Therefore it had become a matter of the salvation of humanity that Germany should not again be entrusted with the power to repeat the damage which she had been inflicting during the present war.

It was necessary, first of all, to crystallize public sentiment into some concrete and definite understanding of the method by which they could put it beyond the power of any individual to buy German goods, or, if he bought them, to make the price so high that the goods would no longer be attractive. The ordinary machinery for accomplishing such a result was that of tariffs. Mr. Armstrong had spoken with many representatives of both political parties in Great Britain and had become convinced that all were now a unit upon the subject of dealing with the tariff question on national and economic lines. Prominent Liberals had told him that there would be no resumption of the tariff fight. The free trade and conscription fights in Great Britain had gone into the melting pot. England would deal in future with the tariff problem from an entirely new angle, so that the way would be clear for working out a plan for consolidating and strengthening the whole Empire.

The British Government and nearly every important commercial association in Great Britain had taken the matter actively in hand and were calling for some form of preferential trade arrangements which would be effective along these lines. Sir Richard Musgrave, secretary of the London Chamber of Commerce, had put the matter in a very definite form, saying that what they had in view was, first of all, to make arrangements for looking after the interests of the Empire, then to do all they could to promote the interests of the allies, then to treat with neutrals as they had deserved, and finally to deal with the enemy and to take the necessary steps to exclude his trade from allied countries. Invitations had been sent out, Mr. Armstrong said, for a meeting on June 4th, of the Imperial Chamber of Commerce, to be held in London, the chief object of which would be to get the best business opinions from the different portions of the Empire to aid in working out the commercial problems which would develop after the war. First of all, he believed, there would be a trade preference given within the British Empire,

It was important, therefore, to perfect their representation in all the countries which make up the Empire, in Australia, New Zealand, South Africa, the Crown Colonies, India, etc. The Export Association of Canada had already been able to make arrangements for representatives in New Zealand and Australia, both of which organizations were working extremely satisfactorily, except for the difficulty in securing transportation. These representatives would no doubt become distributing machinery of great value. In England Mr. Armstrong had been able to conclude arrangements for promoting Canada's trade with the Crown Colonies. He had even been able to secure orders for many thousands of dollars worth of material, which, in most cases, unfortunately, we could not supply because we were so heavily engaged in the production of war order materials. Canada, however, could count upon a very large field for her manufactured goods in these colonies in the future.

In regard to India and the east it had appeared to him to be inadvisable to open up connections there at present when they were unable to furnish either the goods or the transportation. The promotion of trade in these countries might be left in abeyance for the time being.

In South Africa they were being pressed by the Trade Commissioner, Mr. Egan, to extend their organization and to help in building up Canada's trade with that country.

Perhaps the most difficult country of all to deal with was Great Britain, especially under the present restrictions in regard to transportation. The recent statement by Mr. Lloyd George that the Government of Great Britain had made a mistake in not taking complete control of shipping at the beginning of the war was of great importance. Mr Armstrong believes that if the Government should take control of shipping, Canada would really be benefited thereby because, when tonnage is scarce it is inadvisable to tie up shipping in carrying goods from very distant countries such as Australia and the Argentine, when the necessary materials can be had from countries such as those of North America which are so much nearer Great Britain.

At the beginning of the war Great Britain had lost considerable confidence in the ability of Canada to supply war materials. In those days the manufacturers of Canada had not been organized, nor had they been able to study all the important aspects of the problem.

Mr. Armstrong drew attention to Germany's former strong position in regard to international trade. After the war, many countries would be urgently in need of articles which formerly were only made in Germany. The allied countries could only complete Germany's economic defeat by supplying these materials. Russia had been buying 300 million dollars worth of goods from Germany annually, in fact over fifty per cent. of the manufactured goods she imported. She could not produce these goods herself. As soon as the war was over she would have to get them. She would not be able to buy them from France or Belgium, because all of Belgium and the finest manufacturing districts of France had been devastated by Germany. She would have to turn to Great Britain, which country, being fully occupied, would only be able to take care of a portion of the demand. So Russia would have to come across the Atlantic. She would come to Canada, beyond any doubt. But she would not come to Canada to anything like the possible maximum ex tent unless we went to Russia first, and showed her our ability to furnish such materials as she required. We must therefore study the markets of Russia and organize our production, distribution and finance, otherwise this business would go to the United States, which was already organizing for the purpose in the most thorough manner possible.

Mr. R. J. Young, Joint Manager of the Export Association of Canada, Limited, also spoke briefly, emphasizing what Mr. Armstrong had said regarding the importance of organization and stating that he intended to call upon as many Canadian manufacturers as possible, chiefly those directly interested in the export situation, so as to urge upon them the necessity for joining the Association. Some time in June or September they intended to hold a Canadian National Export Trade Convention which would bring together the carriers, the financiers, the manufacturers and every other national interest which was a factor in the building up of export trade.

Personal

Mr. M. J. Costello, of Seattle, traffic manager on the Pacific division of the Great Northern Railway, stated recently that the railway would proceed this year to construct more concrete snow sheds in the Cascades.

Mr. W. W. Pearse, city architect of Toronto, favors a new type of revolving door, which, upon cross pressure being applied, collapses, thus creating two clear openings with the collapsed door in the centre. The old type of revolving door is not condemned by Mr. Pearse, but he points out that in case of panic it would certainly be a source of danger.

Mr. Christopher J. Yorath, civic manager of Saskatoon, Sask., delivered an interesting address before the Ottawa Board of Trade on February 18th, his theme being Civic Government. Mr. Yorath, who is an expert on this subject, outlined the various systems of conducting municipal administration. The impression his remarks made on his hearers was evidenced by the discussion which followed.

Mr. A. F. Macallum, city engineer of Hamilton, Ont., has been elected president of the Society of Engineers of North America. He also received another tribute to his abilities recently in being asked by the Canadian Fire Underwriters' Association to act as their arbitrator in connection with hydraulic disputes in several Canadian cities. Stress of local business made it necessary for Mr. Macallum to decline this offer, however.

Messrs. Forrest & Lightfoot, consulting engineers and contractors, have opened an office in Morin Block, Mountain Hill, Quebec. Both of these gentlement have had much experience in their work. Mr. Lightfoot has been connected with the contracting business for eighteen years. He was an engineer on the staff in connection with the construction of the immense Transcona shops at Ottawa. Mr. Forrest is well and favorably known in Quebec. He was but recently Government engineer in charge of the construction of the St. Malo shops in Quebec. He has also been connected with railroad and building construction work, both in the United States and Canada.

Mainly Constructional

Rees & Hawken, builders, Toronto, have dissolved partnership.

The Eastern Machinery Company, Montreal, Que., have registered.

The Phoenix Building Company, Limited, Quebec, Que., have been granted a charter.

The Andrews Wire Works of Canada, Limited, Watford, Ont., suffered loss by fire recently.

MacIntyre Granite Quarries & Manufacturers, Limited, have been incorporated, headquarters in Winnipeg.

Phoenix Iron Works, Limited, is the name of a new Vancouver concern incorporated with a capital of $10,000.

Thomas Tomlinson, proprietor of the iron foundry business of Tomlinson & Son, Toronto, died on February 22.

The Western Ontario Clay Workers held their nineteenth annual convention in the Builders' Exchange, London, Ont., on February 23 and 24.

It is announced that, as the entire staff of the firm of Chadwick & Beckett, architects, Toronto, are now on active service or making munitions, the office has been closed.

Building permits issued by the city of Chatham, Ont., in the month of January, 1916, totalled $9,500—an increase of $6,525 over January, 1915, when the value of the permits issued was $2,975.

The H. P. Peterson Construction Company, Limited, has been incorporated, and will carry on a general contracting and engineering business in Vancouver, B. C. The capital stock of the company is $10,000.

A fire causing a loss estimated at between fifty and one hundred thousand dollars occurred on the 10th ult. at the premises of the Record Foundry and Machine Company, Moncton, N. B. The loss is covered by insurance.

The partnership which existed between John Hastie and McPherson & Fullerton Bros., as contractors in the city of Victoria under the style of the British Columbia Construction and Engineering Company, has been dissolved by mutual consent. Mr. John Hastie will continue the business.

Hayden, Stone & Company, of Boston, have organized under Massachusetts laws the Cuban Portland Cement Company, to manufacture and sell Portland cement in Cuba. The new company will have an authorized capital of 200,000 shares, par $10, of which 100,000 are to be sold by the company at $15 a share.

Plans are being prepared for a big steel bridge over the Peace River at Peace River Crossing, Alberta. It will include a traffic deck, and the total cost of construction will be about three-quarters of a million dollars. The building of this bridge will enable the line of the Central Canada Railway Company to be continued westward.

The annual meeting of the Manitoba Good Roads Association was held in the board room of the Industrial Bureau, Winnipeg, on February 14. The president, Mr. S. R. Henderson, submitted his sixth annual report, showing the excellent work accomplished by the association during the year in all matters pertaining to better roads.

The annual convention of the Provincial Builders' and Supply Association was held on February 22 and 23 in the rooms of the Builders' Exchange, Hamilton, Ont. There was a good attendance. Mr. George Gander, of Toronto, president of the association, presided. On the evening of February 22 the delegates were entertained at a banquet held in the Wentworth Arms.

The Princess Theatre, Toronto, is to be rebuilt. If arrangements can be made, the work will be started at once, in the hope that the theatre will be ready for the season commencing in September. The seating capacity will be increased from 1,850 to 2,200, and the building will be made twenty feet wider. The work is expected to cost in the neighborhood of $200,000.

W. A. McLean, Deputy Minister of Public Works for Ontario, reports that in accordance with the provisions attending increased Government grants to municipalities undertaking schemes of roadway construction, plans for an improved system of roadways are being prepared by the following counties:—Brant, Lambton, Kent, Victoria, Elgin, Prescott, Dundas and Stormont and Glengarry.

The expenditure during the past fiscal year on the Quebec Bridge was $2,816,305, paid out of capital, making the total capital expenditure on the reconstruction of the bridge $7,764,393. The total expenditure by the railway department up to the end of the year in connection with this bridge is given as $8,198,748, irrespective of the subsidy of $374,253, paid by the Quebec Bridge Company, and of the sum of $6,975,266, paid for the guaranteed bonds of that company.

"Better Roads for Alberta," was the subject of an address given by the president, Mr. J. H. Lamb, at the recent convention of the Alberta Association of Local Improvements, held in Edmonton. Mr. Lamb said that the Government had spent over six million dollars since 1905 on roads and bridges in the province, but a great many miles of roads were to-day in the ditch. He urged the maintenance of the roads, and the construction of permanent roads throughout the province—particularly on behalf of the farmers, who, he said, did not receive benefits commensurate with the vast sums expended on roads.

Messrs. Pearson and ~~Martin~~ MARCHAND, the architects who were asked by the Government to examine the condition of the Ottawa Parliament Building after the fire, report that with the exception of the central interior and the rear walls the structure itself can be repaired without entirely rebuilding. Most of the walls are still intact, and what is left of the building represent a value in labor and material of approximately two million dollars, or considerably over half of the original cost. A tentative ground plan of the main Parliament Buildings has been prepared, and it is probable that an early start will be made on the work of reconstruction.

Saskatoon is in a fair way for adding another to its industries, in the form of reinforced concrete products, which is likely to commence operations this spring. Mr. A. C. McEown has an incorporation with extensive powers known as "Sand and Gravel Deposits, Limited," the object of which is to manufacture concrete chimneys, fence posts, window sills, ornamental work, etc. Mr. McEown is now showing a reinforced concrete block for chimneys, which will be made in different sizes. This chimney, it is contended, will not sweat or drip, and will give perfect ventilation. When built, the chimney has a double wall with an air space between, and is reinforced with wire running through each wall and the connecting walls.

The opening proceedings of the annual convention of the International Association of Master House Painters and Decorators of the United States and Canada, which was held in Cincinnati last month, were delayed for thirty minutes because no British flag bearing the coat-of-arms of Canada was displayed in the decorative scheme of the hall where the meeting was held. There were two American flags draped above the speaker's stand, and between them was the United States shield, with an insert of the Canadian coat-of-arms. Many Canadians are members of the Association, and those present at the convention refused to consider any business until a British flag bearing the Canadian shield was included in the display. A committee appointed for the purpose succeeded in finding such a flag after spending half an hour in visiting many stores.

Mr. James H. McKechnie, president of the Canadian Consolidated Rubber Company, Limited, and also president of the Canadian Consolidated Felt Company, Limited, passed away on February 8, following a brief illness of ten days. In 1877 Mr. McKechnie commenced the manufacture of waterproof clothing, and in 1883, in company with the late S. H. C. Miner and others, organized the Granby Rubber Company, of which he became general manager. When that company was amalgamated with the Canadian Consolidated company Mr. McKechnie became vice-president of the latter, and in April 1915 was elected president. His sterling qualities and fine character exerted an influence for the betterment, not only of business conditions, but of the community in which he lived. That his death is sincerely regretted is evidenced by many messages of sympathy that have been received from all parts of Canada and the United States.

The men who have been engaged in making charts of the different channels in the Fort William, Ont., harbor will finish their task shortly, according to Mr. Craig, the local government engineer. Each winter, after ice has formed upon the water, a chart is made of the channels, showing the depths, widths, and other particulars, so that the government is able to strike an estimate of the amount of money required to carry on the harbor work during the months of navigation. It is too early yet to get any line on just how much work will be done in the harbor this year, but it will likely be of considerable quantity. Some of the old channels have to be deepened, and it is probable that efforts will be made to complete the turning basin in the Kaministiquia River above the Grand Trunk Pacific railway bridge. Between ten and fifteen acres of land remains to be dredged out. Another undertaking which most likely will be completed this summer is the new breakwater at the Mission. Part of this huge concrete wall was seriously damaged last fall in a big snow storm, when it was cracked and part of it shifted.

The special committee appointed by the Quebec Health Committee to make a test of the city's water supply and to confer with experts on the best means of purifying it have recommended the adoption of a sterilizing system of chlorination as the most practical for the time being, in view of the vast expenditure which a filter system would entail. The latter system, it was pointed out, would cost about $300,000, besides an additional $35,000 a year for upkeep. On the invitation of the special committee Mr. George A. Johnson, expert sanitary engineer, of New York, has been in Quebec making a thorough inspection of the water-works. In his report Mr. Johnson says that the water shows the presence of bacteria of sewage origin, and strongly recommends the immediate construction of a filtration plant as the only means of rendering the water pure. He points out that sterilization by chlorination will not do more than kill a large proportion of the bacteria, but advises the installation of such a plant pending the construction of a filtration plant. When the filtration plant has been built and put in operation, says Mr. Johnson, the chlorination plant can be made a part of it, and be continued as a desirable adjunct to the filtration process of purification.

New Books

The Colorado Industrial Plan—by John D. Rockefeller, Jr. This booklet contains a complete copy of the Plan of Employees' Representation—or "Industrial Constitution"—and the agreement between the company and its employees adopted at the coal and iron mines of the Colorado Fuel and Iron Company. In order that the scope and purpose of the plan may be more clearly understood, there are also included an article entitled "Labor and Capital—Partners," reprinted from the Atlantic Monthly for January, 1916, and two addresses delivered by John D. Rockefeller, Jr., while in Colorado in October, 1915.

Altitude in Canada—by James White, F.R.S.C., F.R.G.S., assistant to chairman and deputy head of the Commission of Conservation of Canada. The report is accompanied by a number of valuable maps, showing the profiles and altitudes along the transcontinental lines, C. N. R., C. P. R., and G. T. P. An interesting map also is that showing the high and low levels since 1866 of the four Great Lakes.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Anderdon Township, Ont.
The Township Council contemplate a large amount of drainage this season. Clerk, A. C. Mailloux, Amherstburg.

Brant County, Ont.
The County Council. in conjunction with the Ontario Highways Board, are considering the establishment of a good roads system. Engineers, Jackson & Company, Temple Building, Brantford.

Brantford, Ont.
G. A. Ward, Chairman of the Board of Works, will receive tenders until noon, March 13th, on the supply of vitrified sewer pipe, sizes 6 to 24-inch. Specifications at office of the Engineer, T. H. Jones.

Drummondville, Que.
The Town Clerk, W. A. Moisan, will receive tenders until 7 p. m., March 15th. for the construction of a pumping station and mechanical gravity filters. Plans and specifications at office of the Clerk and of the Consulting Engineers, M. M. Ouimet & Lesage. 76 St. Gabriel Street, Montreal.

Dudswell, Que.
The Municipality propose to spend $4,000 during the year on the construction of roads. Secretary, H. Cunningham.

Humberstone, Ont.
The Village Council propose to spend $3,000 on roads and sidewalks. Clerk, John J. Wichman.

Leeds & Lansdowne Township, Ont.
The expenditure of $8,000 on roads is being considered by the Township Council. Clerk. J. D. W. Darling. Lansdowne, Ont.

Lindsay, Ont.
The Town Council are considering the expenditure of $2,500 on sewers, $2,500 on sidewalks and $2,500 on waterworks. Clerk, D. Ray.

London, Ont.
The City Council contemplate the laying of asphaltic concrete pavement on Waterloo Street and Carfrae Crescent, at an approximate cost of $23,200. Clerk, S. Baker.

The City Council propose to purchase an asphalt plant and to submit tenders on all paving required during the year. Engineer, H. A. Brazier.

Moncton, N. B.
The City Council contemplate the expenditure of $60,000 on sewers and $50,000 on pavements. Clerk. J. S. Magee. Engineer, J. Edington.

Napanee. Ont.
Work by day labor will start in the spring on the construction of cement walks for the Town Council. Clerk, W. A. Grange. Estimated cost, $5,000.

Niagara Falls, Ont.
Tenders will be received until noon, March 8th, by B. Carr, Secretary to the City Council, for excavation and backfilling of trenches for watermains.

Pelee Island, Ont.
The Township Council will shortly call for tenders on a quantity of ditching and rock blasting for Big Marsh improvements. Particulars from C. Parsons, Pelee Island.

Port Credit, Ont.
The Village Council have passed a bylaw providing for the construction of a number of sidewalks. Clerk, F. W| Ott.

Preston, Ont.
The Town Council propose to spend $25,000 on pavements and $5,000 on sewers and sidewalks. Clerk, H. C. Edgar.

Quebec, Que.
The City Council contemplate purchasing an asphalt plant at an estimated cost of $12,000 and the installation of a filtration plant. Engineer, W. D. Baillairge.

Regina, Sask.
Tenders will be received until noon, April 1st, by the Division Engineer, T. C. McNabb, Moose Jaw, for paving approaches to the freight sheds. Plans, etc., with the Division Engineer, with J. G. Sullivan, Chief Engineer, Winnipeg, M. McKenzie, Resident Engineer, Regina, C. S. Moss, Resident Engineer, Moose Jaw, and E. A. Kelly, Resident Engineer, Saskatoon.

St. Francois, Que.
The expenditure of $5,000 on sidewalks is proposed by the Municipal Council. Clerk, J. D. Jutras.

Toronto, Ont.
Commissioner of Works R. C. Harris has recommended the construction of an asphalt pavement on Pacific Avenue at an estimated cost of 47,800 and a brick block pavement on Lansdowne Avenue at an approximate cost of 5.821.

Truro, N. S.
The Town Council propose to construct about 1,300 yards of concrete sidewalks this season. Clerk, H. McDougall.

Valleyfield, Que.
The Town Council are about to start work on the laying of a macadam pavement, estimated to cost $5,000 and the construction of cement walks at an approximate cost of $4,000. Engineer, Oscar Viau.

CONTRACTS AWARDED

Ottawa, Ont.
The City Council have let the contract for the supply of pipe required in the construction of the distribution system to the National Iron Works, Ltd., Cherry Street, Toronto.

Railroads, Bridges and Wharves

Esquimalt, B. C.
The sum of $200,000 for improvements to the dry dock is included in the estimates of the Department of Public Works, Ottawa. Secretary, R. C. Desrochers.

Marieville, Que.
The Town Council are considering the erection of a concrete bridge, estimated to cost $4,000. Clerk, J. E. Ostiguy.

North Vancouver, B. C.
The District Council have instructed Engineer A. M. West to prepare estimates of the cost of repairs to the wharves at Cove Cliff and Woodlands.

Toronto, Ont.
The Board of Control will receive tenders until March 14th for special track work, etc., for the Civic Railway. Plans at Room 12, City Hall.

Vancouver, B. C.
The Department of Public Works, Ottawa, have included in their estimates the sum of $350,000 for harbor improvements.

Victoria, B. C.
Provision has been made in the estimates of the Department of Public Works, Ottawa. for improvements to the harbor. Approximate cost, $100,000.

Warwick Township, Ont.
The Township Council propose to spend about $6,000 on bridges throughout the Municipality. Clerk, N. Herbert, Watford, Ont.

CONTRACTS AWARDED

Victoria, B. C.
The Canadian Northern Railway Company, Toronto, have awarded the contract for the construction of a wooden bridge over Selkirk Water to S. Doe, 522 Sayward Building.

Public Buildings, Churches and Schools

Alberta Province.
The Department of Public Works, Ottawa, have made provision in their estimates for the erection of the following buildings:—

Grand Prairie, Immigration Hall, $3,000.
High River, Public Building, $20,000.
Macleod, Public Building, $25,000.
Medicine Hat, Immigration Hall, $20,000.
Red Deer, Public Building, $34,000.
Vegreville, Public Building, $25,000.
Vermillion, Public Building. $20,000.
Wainwright, Public Building, $20,000.

Bracebridge, Ont.
The School Board are considering the installation of lavatories at the schools. Estimated cost. $4,000.

Cayuga, Ont.
The Board of Education propose to build a new wing to the school. Brick construction. Secretary, E. B. Davis, Cayuga.

Davidson, Sask.
The erection of an office building is contemplated by D. S. Hutcheon.

Delia, Alta.
The erection of a school is contemplated by the Trustees of School District No. 3261. Estimated cost, $3,000.

Emerson, Man.
The School Board are considering the erection of an addition to the school.

Exeter, Ont.
Alterations to the Sunday School rooms of James Street Methodist Church are being considered. Estimated cost, $4,000.

Fitch Bay, Que.
The School Commissioners are having plans prepared for a school, estimated to cost $3.000. Secretary B. H. Rider.

Fort William, Ont.
It is intended to rebuild St. Luke's church, which was recently destroyed by fire. Pastor, Rev. Canon Burt, 213 Cameron Street.

Joliette, Que.
Tenders on the erection of a school will be called in about one month. Stone, brick and frame construction. Approximate cost, $20,000. Secretary to the School Commissioners, J. M. Mondor.

Masonville, Ont.
The erection of an addition to the school is being considered by the London Township Council. Secretary, Mary Grant, 110 Dundas Street, London.

New Dundee, Ont.
Work on the erection of a Town Hall will start shortly under the supervision of Charles Beckman. Frame construction.

North Ridge, Ont.
Plans are being prepared by J. C. Pennington, La Belle Building, Windsor, for a school to be built for the Public School Trustees. Concrete block and brick construction, concrete foundation, shingle roofing. Estimated cost, $5,000.

Stamford Township, Ont.
Tenders will be received until March 14th on the erection of a school for the Trustees of School Section No. 2. Plans at office of the Architect, J. U. Collins, 49 Benson Street, Niagara Falls. Red brick construction, stone foundation. Approximate cost. $6,000.

Stanstead, Que.
Loomis, Dakin Ltd., St. Gabriel Street, Sherbrooke, Que., general contractors for the Registry Office and Municipal Hall now in course of erection, will do all work except heating, plumbing and electrical work.

CONTRACTS AWARDED

Berlin, Ont.
The contract for installation of electric wiring and fixtures at the Post Office has been awarded by the Department of Public Works, Ottawa, to A. Lockhart & Company, Berlin.

Hull, Que.
The general contract for the erection of a church on Chaudiere Street for the Parish of the Holy Redeemer has been let to Noel & Monette, St. Patrick Street, Ottawa. Estimated cost, $150,000.

London, Ont.
The contract for installation of wiring and electric fixtures at the County Buildings has been let to the Benson-Wilcox Electric Company, 264 Dundas Street.

Business Buildings and Indu - trial Plants

Arkona, Ont.
H. Johnson is having plans prepared for barns to cost about $3,000. Work will start in the spring. Frame construction, concrete foundation, shingle roofing.

Barrie, Ont.
The Bell Telephone Company propose to build an office building on Elizabeth Street. Manager, A. G. Price.

Bathurst, N. B.
W. J. Kent & Company, Ltd., intend to rebuild their premises immediately. Brick construction.

Brampton, Ont.
The Omeka Farms have purchased about 300 acres and intend to build a number of cottages, workships, chapel and school. Architect not yet appointed. Superintendent, J. A. Mundell, Box 38, Brampton.

Campbellford, Ont.
The Northumberland Paper & Electric Company are making arrangements for the rebuilding of their plant, and work may start shortly.

Davidson, Sask.
The erection of a garage is contemplated by E. R. Mann & Son, Railway Street.

Chatham Township, Ont.
Gordon Mayville, Chatham Gore, is considering the erection of barns to replace those recently destroyed by fire.

Dungannon, Ont.
The erection of a store and residence is contemplated by Allen & McFarlane, R. R. No. 1 Dungannon. Estimated cost, $4,000.

East Branch, Ont.
W. McKarl, Wallaceburg, Ont., is preparing plans for barns to be erected in the spring. Estimated cost, $3,000.

Fort William, Ont.
Plans are being prepared for a feed mill to be built on River Front for the Ogilvie Flour Mills Company, Ltd. Architects, Barnett & McQueen, Christina Street. Reinforced concrete construction, pile and concrete foundation. Estimated cost, $150,000.

D. A. Gordon, Luci Court, is preparing plans for an elevator to be built for Guy & Company, 406 Grain Exchange Building. Crib construction, pile and concrete foundation. Estimated cost, $20,000.

Kedgwick, N. B.
Work will start shortly on the erection of a lumber mill for the Richards Manufacturing Company. Plans have been prepared by R. McLean, builder. Frame construction, fireproof roofing. Estimated cost, $4,000.

Lindsay, Ont.
Horne Bros., William Street, are having plans prepared for woollen mills Manager, Alexander Horne.

Loretteville, Que.
Work is about to start on the erection of a sawmill for J. Boule. Wood, cement and metal construction. Estimated cost, 10,000.

Mimico, Ont.
The Grand Trunk Railway Company propose to build a station and a conference will be held to decide upon site and other details. Clerk to the Village Council, A. J. Telfer.

Moncton, N. B.
Albert Sincennes, 642 Main Street, is preparing plans for a store building to be erected for W. S. Smith, Main Street. Tenders will be called early in March. Approximate cost, $8,000.

Ottawa, Ont.
Horwood, Taylor & Horwood, 130 Sparks Street, are preparing plans for a rink to be erected on Argyle Street. Work may proceed in the near future. Owner's name withheld.

Pelee Island, Ont.
Sketch plans of a store and warehouse are being prepared for Norman MacCormick by J. C. Pennington, La Belle Building, Windsor. Concrete and brick construction.

Peterboro, Ont.
Plans are in course of preparation for a store house and elevator to be erected on George Street for the Campbell Flour Mills, Company, Ltd., George Street. Concrete foundation, galvanized corrugated iron construction. Head office of Company, Cawthra Avenue, Toronto.

Quebec, Que.
The Quebec Central Railway, Sherbrooke, Que., are building an office and freight shed by day labor under the supervision of J. A. Shield, 34 Dalhousie Street. Frame construction, metal and asbestos roofing. Approximate cost $8,000.

Saskatchewan Province.
Tenders on the erection of stations at Admiral, Scotsguard and Meyronne for the Canadian Pacific Railway will be received until noon, April 1st, by the Division Engineer, T. C. McNabb, Moose Jaw. Plans, etc., with the Division Engineer and with the following Resident Engineers:—J. G. Sullivan, Winnipeg, M McKenzie, Regina, C. S. Moss, Moose Jaw and E. A. Kelly, Saskatoon.

Selkirk, Ont.
J. W. Holmes contemplates the erection of a store at an approximate cost of $5,000.

Smooth Rock Falls, Ont.
The Mattagami Pulp & Paper Company, Ltd., are about to start work on the construction of a sulphite mill. The company also propose to build a sawmill and a model town for their employees. General Manager, A. G. McIntyre, 706 Traders Bank Building, Toronto.

Sorel, Que.
The City Council are considering the erection of a Fire Hall. Particulars from Clerk.

Stratford, Ont.
T. G. Hepburn, 29 Downie Street, is preparing plans for an addition to the premises of the Williams Trow Knitting Company, St. Patrick and Erie Streets. Work includes the installation of a freight elevator.

St. Jerome, Que.
The St. Jerome Manufacturing Company, Ltd., will call for tenders in the early spring for the erection of an addition to their factory. Stone, brick or cement block construction.

St. John, N. B.
F. Neil Brodie, 42 Princess Street, is preparing plans for alterations to the premises of J. M. Roche, King Street.

Three Rivers, Que.
The Canada Iron Corporation propose to make an addition to their plant.

Toronto, Ont.
Work is about to start on alterations to the theatre owned by John Wollson, 1184 Queen Street W. Seating capacity is to be more than doubled.

Vancouver, B. C.
The Department of Public Works, Ottawa, will receive tenders until 4 p. m., March 23rd, for the erection of a freight shed on the Government Wharf. Plans and specifications at office of the District Engineer, Victoria, with the Postmaster, Vancouver, and at the Department. Specifications only at office of MacLean Daily Reports, Ltd., 25 Charlotte Street, Toronto.

Wainwright, Alta.
Tenders on the erection of a flour mill for the Wainwright Milling Company will be called early in April. Architects, C. E. Bird & Company, 616 Corn Exchange, Minneapolis. Approximate cost, $35,000.

Walkerton, Ont.
Frank Antona is considering the erection of a brick warehouse and store.

Walsingham, Ont.
D. A. Langfield is having plans prepared for a barn, estimated to cost $3,000. Timber construction, stone and concrete foundation.

Weston, Ont.
The recently incorporated Weston Golf Club, Ltd., will build a club house in the spring and make alterations to existing buildings. H. J. Church, Main Street, is an interested party.

Windsor, Ont.
Walker & McPhail, Tuson Building, are preparing plans for alterations to a store on Ouellette Avenue for the Heintzman Piano Company. Estimated cost, $3,000.

J. C. Pennington, La Belle Building, is preparing plans for a warehouse to be built on Glengarry Street for Salzenstein Bros., Erie Apartments, Erie Street. Concrete block construction, concrete foundation, composition paper roofing. Estimated cost, $3,000.

Wingham, Ont.
W. Leppard is considering remodelling his hotel and the erection of new stables, at an approximate cost of $4,000.

CONTRACTS AWARDED

Belleville, Ont.
The Department of Public Works, Ottawa, have let the general contract for the erection of a freight shed, etc., to E. Conroy and H. Hickey, 417 Stewart Street, Peterboro.

Dundas, Ont.
The Public Utilities Commission have let the general contract for the erection of an office and store to the Dickson Building Company, Ltd., King Street.

London, Ont.
The contract for plumbing required in connection with the car barns which have been built for the London, Port Stanley Railway Board has been let to Noble & Rich, 237 Queen's Avenue, at $4,195.

Montreal, Que.
The sub-contract for reinforcing steel required in connection with the erection of a grand stand at the Blue Bonnets Race Track has been awarded to W. H. Wardwell, 413 New Birks Building.

The general contract for repairs to the Hotel Prince for J. Pullam, 858 Tupper Street, has been let to M. B. Shaw, 151 Metcalfe Street.

In connection with the store and residences which have been erected for E. Gagnon, 525 Dandurand Street, the brick work contractor is J. Perron, 393 First Avenue, Rosemount, and the electrical work has been let to Lafreniere & Bissonnett, 377 Fifth Avenue, Rosemount.

Work has been started on the erection of five stores and residences on Mount Royal Avenue. The general and masonry contracts have been let to William Boivin, 317 Fourth Avenue, Rosemount, and the brick work to Primiano Lopa, c|o the general contractor. Tenders on smaller trades are now being received by the general contractor. Owner's name withheld.

Rock Island, Que.
The general contract for the erection of a factory and store for G. &. G. Ltd., Stanstead, has been let to Loomis, Dakin Ltd., St. Gabriel Street, Sherbrooke, and work has been started. Estimated cost, $15,000. This work has been previously reported as being at Stanstead.

Stratford, Ont.
The general contract for the erection of an addition to the factory of the Avon Hosiery Company, Erie Street, has been let to Kalbfleisch Planing Mill Company, 106 Milton Street, the brick work to F. Marson, c|o the general contractors, and the plastering to W. Soeder, 210 Huron Street. Estimated cost, $12,000.

The general contract for alterations and additions to the Sunday School of St. Andrew's Church has been let to R. L. Oman, 24 Earl Street. Work includes the erection of a gallery.

Toronto, Ont.
Work has been started on the erection of an addition to the engine room of the Harris Abattoir Company, Ltd., Union Stock Yards. The contract has been let to Wells & Gray, Confederation Life Building. Brick construction. Estimated cost, $7,000.

The general contract for alterations and additions to a factory on Strachan Avenue for the W. K. Kellogg Cereal Company, Battle Creek, Mich., has been awarded to J. Rees, 705 Manning Avenue.

Whitebread, Ont.
N. Young and T. Kilbride, Wallaceburg, Ont., have let contracts for steel barns to H. A. MacDonald, Whitebread. Steel frame construction.

Windsor, Ont.
The Windsor & North Essex Agricultural Society have let the following contracts for the erection of an addition to the agricultural building at the Race Track:—masonry, R. Wescott, 55 Oak Street; carpentry, W. Dupuis, 147 Dougal Street; roofing and plumbing, Pennington & Brian, Sandwich Street E.; painting, Lossing & Harris, 109 Church Street.

Residences

Aldershot, Ont.
Tenders will be called shortly for the erection of a residence for F. W. Easterbrook. Architect, J. A. Armes, 68 Federal Life Building, Hamilton. Pressed brick construction, tile foundation, shingle roofing. Estimated cost, $5,000.

Ameliasburg Township, Ont.
W. W. Anderson, Rossmore, Ont., proposes to rebuild his residence this season. Estimated cost, $4,000.

Atwood, Ont.
George Gordon, Main Street, is having plans prepared for improvements to ris residence. Work will include veneering with white brick.

Exeter, Ont.
Mrs. T. Brock is considering the erection of a residence, estimated to cost $3,000. White brick construction.

The erection of a residence is contemplated by H. Jones & Son. Brick construction. Estimated cost, $3,000.

Fred Brock is considering the erection of a residence. Brick construction. Estimated cost, $3,000.

Charles B. Snell contemplates the erection of a residence at an approximate cost of $3,000. Brick and concrete construction.

London, Ont.
George Mills, 527 Dundas Ctreet, proposes to build a residence in the spring. Estimated cost, $3,000.

Albert Vincent, c|o R. C. Struthers & Company, is considering the erection of one or two residences in the spring, and will prepare plans. Estimated cost, $3,000 each.

Frank Moore, 25 Kensington Street, contemplates the erection of two residences, estimated to cost $5,000. Plans will be prepared.

Meaford, Ont.
The erection of a residence is contemplated by William McCutcheon, Garryowen, Meaford. Owner will prepare plans.

Montreal, Que.
Henri Demers, 1379 De La Roche Street, has commenced the erection of four flats, estimated to cost $5,000, and is receiving tenders on roofing, heating, plumbing and electrical work. Brick construction, stone foundation, felt and gravel roofing.

E. Pepin, 129 Marlowe Street, is receiving tenders on roofing, heating, plumbing and electrical work required in connection with the flats which he is building. Brick construction, concrete foundation, felt and gravel roofing. Approximate cost, $4,000.

Orford Plains, Ont.
John B. McDonald, Orford Plains, Rodney, Ont., proposes to remodel his residence. Work will include veneering.

Ottawa, Ont.
Work is about to start on alterations to apartments on Laurier Avenue W. for Donald Fraser, 82 O'Conner Street. Most of work will be done by owner. Estimated cost, $3,000.

The Oakland Land Company, 1111 Bank Street, are considering the erection of a number of residences at an average cost of $4,500. Brick veneer construction, stone foundation, shingle roofing. Plans will be prepared.

Outlook, Sask.
J. A. Fraser intends to build a residence this summer. Estimated cost, $5,000.

Quebec, Que.
A. Z. Lefebvre, 109 Marie Louise Street, has commenced the erection of a residence, estimated to cost $5,000. Brick and frame construction, stone foundation, metal and asbestos roofing.

St. Jerome, Que.
A. Vaillancourt, Labelle Street, will call for tenders early in the spring for the erection of a residence. Brick and frame construction.

St. John, N. B.
A bill will be presented at the next sitting of the Provincial Legislature to authorize the City to build homes for working men. Clerk, H. E. Wardroper.

Sutherland, Sask.
Tenders will be received until 4 p. m., March 23rd, by R. C. Desrochers, Department of Public Works, Ottawa, for the erection of a boarding house at the Forest Nursery Station. Plans and specifications at offices of W. T. Mollard, Clerk of Works, Regina, the Superintendent, Forest Nursery Station, Sutherland, with the Postmaster, Brandon, and at the Department. Specifications only at office of MacLean Daily Reports, Ltd., 25 Charlotte Street, Toronto.

Toronto, Ont.
Tenders on wiring and lathing required in connection with the residence which has been erected at 1238 Kingswood Road are being received by G. H. Wallace, 236 Kingswood Road.

Tenders are being received by W. B. Galbraith, 22 St. Leonards Avenue, for the erection of a residence at Lawrence Park. Hollow tile and brick construction. Estimated cost, $7,500.

Warwick Township, Ont.
Malcolm Perry, R. R. No. 2, Watford, Ont., contemplates the erection of a residence.

Wesley McKay, R. R. No. 2, Watford, Ont., is considering the erection of a residence.

Windsor, Ont.
Peter Octerhout, 23 Pitt Street E., is preparing plans for a number of bungalows to be built on Pierre and Lincoln Streets. Frame construction, concrete foundation, shingle roofing. Estimated cost, $3,000.

CONTRACTS AWARDED

Montreal, Que.
W. L. Ployart, 181 Harvard Avenue, has let the general contract for the erection of a residence on Grosvenor Avenue to Anglin's Ltd., 65 Victoria Street. Work will start in the spring. Brick construction, concrete foundation, felt and gravel roofing.

Ottawa, Ont.
In connection with the residence in course of erection for William Eastman, 24 Ossington Avenue, the contract for plumbing has been let to Gervin & Lillico, 1095 Bank Street, and the electrical work to the Dominion Electric Company, 477 Sparks Street.

The general contract for the erection of a cottage on Williard Street for McLeod McAllister, 22 Glen Avenue, has been awarded to J. E. Cooper, 514 McLeod Street. Brick veneer construction, concrete foundation, shingle roofing. Estimated cost, $3,000.

Walkerville, Ont.
In connection with the bungalow to be built on Lincoln Road by the Burns & Walker Construction Company, Tuson Building, Windsor, the plumbing has been awarded to Roy Hicks, 159 Wyandotte Street E., Windsor.

Power Plants, Electricity and Telephones

Chesley, Ont.
Krug Bros. Company, Ltd., are in the market for electric motors, 500 volt, d. c., 5 to 10 h. p.

Dungannon, Ont.
The Goderich Rural Telephone Company, Ltd., propose to make extensions to their system this year.

Emerson, Man.
The Town Council are considering the installation of an electric lighting plant. Clerk, W. W. Unsworth.

Marieville, Que.
The Town Council are considering the installation of an alarm system at an approximate cost of $2,000. Clerk, J. E. Ostiguy.

Pelee Island, Ont.
Albert Muir, c/o Pelee Island Telephone Company, has been appointed to look after extensions and other improvements to the Company's system.

Saskatchewan Province.
The Beadle Rural Telephone Company have been empowered to borrow $4,300 for the construction of their system. Chairman of the Local Government Board, A. J. McPherson.

Whitby, Ont.
The Town Council have instructed the Property Committee to report on the installation of a new fire alarm system. Clerk, Joseph White.

Fires

Beauport, Que.
The Parish Church has been destroyed by fire. Loss, $3,000, partially covered by insurance. Curate, L. A. Deziel.

Bowden, Alta.
The business block owned by C. A. Johnston has been destroyed by fire. Loss, $30,000, partially covered by insurance.

Fort William, Ont.
St. Luke's Presbyterian Church has been damaged by fire and the organ entirely destroyed. Total loss, $5,000.

Moncton, N. B.
The plant of the Record Foundry & Machine Company has been damaged by fire to the extent of about $100,000. Loss is covered by insurance.

Sherbrooke, Que.
Fire has damaged the interior of the Queen's Hotel to the extent of about $4,000. Owner, D. McManamy, 6 Gordon Street.

Sydney Mines, N. S.
The residence of John Barrington, Street, has been destroyed by fire.

Toronto, Ont.
Fire has damaged the warehouse of the William Rennie Company, Ltd., 130 Adelaide Street E., to the extent of about $7,000. Loss is fully insured.

The building owned by James Carnell, 1922 Dundas Street, has been damaged by fire. Loss, $2,100.

Miscellaneous

Brantford, Ont.
The Chairman of the Board of Works will receive tenders until noon, March 13th, on the supply of road oil during the year. Estimated quantity, 120,000 gallons. Specifications at office of the Engineer, T. H. Jones.

London, Ont.
The Fire Chief has recommended to the City Council that an auto tractor and combination waggon be purchased, as well as 1,000 feet of 2½ inch fire hose. Clerk, S. Baker.

Merlin, Ont.
The Town Council are considering the purchase of fire fighting equipment. Particulars from Dr. Bell.

Moose Jaw, Sask.
Tenders on the excavation of a reservoir above the dam for the Canadian Pacific Railway Company will be received until noon, April 1st, by the Division Engineer, T. C. MacNabb, Moose Jaw. Plans, etc., with the Division Engineer, with J. G. Sullivan, Chief Engineer, Winnipeg, M. McKenzie, Resident Engineer, Regina, C. S. Moss, Resident Engineer, Moose Jaw, and with E. A. Kelly, Resident Engineer, Saskatoon.

New Glasgow, N. S.
The Department of Public Works, Ottawa, have extended the time for receiving tenders on the construction of lock gates for the East River Lock until March 13th.

Peace River, Alta.
The Town Council have secured a loan for the purchase of fire fighting equipment. Secretary, A. E. Carlisle.

Saanich, B. C.
Fire Chief Davis will recommend the establishment of three or four fire stations equipped with reels, short ladders and hose. Municipal Clerk, Hector S. Cooper, Municipal Hall.

Walkerville, Ont.
The Canadian Hoskins Ltd., Sandwich Street, are considering the purchase of machinery for the manufacture of wire

goods. Estimated expenditure, $10,000. Manager, R. H. Cunningham.

CONTRACTS AWARDED

Cornwall, Ont.
The Town Council have let a contract for the supply of a boiler and pump to John Inglis Company, Ltd., 14 Strachan Avenue, Toronto, at $2,800.

Montreal, Que.
The Harbor Commissioners, Common Street, have awarded the contract for the supply of Douglas Fir to Mason, Gordon & Company, 80 St. Francois Xavier Street.

The Harbor Commissioners have let the contract for the supply of elm and maple timber and hemlock railway ties to W. H. Kelly, Buckingham.

The City Council have let the contract for the supply of 15,000 tons of sand to J. Aybram, Ste. Emelie de Joliette, Que., and for 200 tons to the Touzin Sand Company, Ltd., 76 Common Street, Montreal.

Tilbury, Ont.
The Union Natural Gas Company, Sarnia, Ont., have let the contract for supply of gas pipe to the National Supply Company, Queen Street E., Tilbury. Approximate cost, $300,000.

Quebec, Que.
La Banque Nationale, 75 St. Peter Street, have let the contract for the erection on St. Foye Road to C. E. Morissette Ltd., 208 Latourelle Street. Estimated cost, $6,000. Brick construction.

West Wawanosh Township, Ont.
The general contract for the erection of a school for the Trustees of School Section No. 4 has been awarded to J. W. Henderson, Lucknow, Ont. Seating, slate blackboards, hot air heating system and other equipment will be purchased by the Secretary, William McQuillan, R. R. No. 4, St. Helens P. O.

Weston, Ont.
A. J. Barker will shortly start work on the erection of a garage on Main Street. Estimated cost, $10,000.

Winnipeg, Man.
Work is expected to start immediately on the erection of the first unit of the proposed store for the T. Eaton Company, head office, Yonge Street, Toronto. The structure will be erected in four units, the last of which will be a new building on the site of the present store. Approximate cost of first unit, $300,000. Fireproof construction, stone facings. Chief Engineer, George W. Thomson, c/o the Company.

Late News Items

Campbellton, N. B.
The Town Council are considering the expenditure of $25,000 on the erection of a Town Hall, and of $5,000 on a street lighting system. Clerk, J. T. Reid.

Dundee Township, Que.
Tenders on the construction of six small concrete bridges will be received until 10 a. m., March 6th, by the Secretary to the Township Council, T. W. Fraser, Dundee. Plans and specifications with the Secretary.

Flos Township, Ont.
Tenders on the erection of a school for the Trustees of School Section No. 5, Flos Township, will be called very shortly. Architect, J. Wilson, Collingwood, Ont. Brick construction, asbestos roofing. Estimated cost, $21,000.

Fort William, Ont.
Fire has destroyed the store and other premises owned by J. Weisner, 132 Ogden Street. Loss, about $8,000. Owner will probably rebuild.

Halifax, N. S.
The School Board, Sackville Street, will probably call for tenders shortly on the erection of a school. Architect, H. E. Gates, Queen Building.

The City Council have let the following contracts for the erection of a residence on Grafton Street:—general contract, Falconer & MacDonald, St. Paul Building; painting, David Roche, 35 Blowers Street; heating, Longard Bros., 213 Hollis Street; plumbing, M. Day, 73 Cornwallis Street; electrical work, J. Starr, Son & Company, Granville Street. Approximate cost, $4,500.

Lachute, Que.
The Town Council have awarded the contract for the construction of a bridge over the North River to Lafleur & Berniquer. Steel construction. Estimated cost, $10,750.

Wood-Block Flooring Said to Have Proved Its Worth

It is only a few years that creosoted wood blocks have been used for the flooring of factories, warehouses and other buildings. Yet they have already proved their worth, judging from information presented at the wood preservers' convention in Chicago by C. H. Teesdale of the U. S. Forest Products Laboratory. Mr. Teesdale has summed up and tabulated the answers to questions submitted to a large number of users of wood-block flooring, as well as the manufacturers of the creosoted blocks. His summarizing of the data received is as follows:

The results of this investigation indicate that treated wood block makes a desirable type of flooring for many purposes, and it is likely that its use for interior work will increase. Since its large use for these purposes is just beginning, one might expect that unforseen trouble would develop. The records of 160 floors indicate, however, that serious trouble has developed in a very low percentage of cases.

Most of the trouble has come from shrinkage or expansion of the blocks. To prevent these troubles it is necessary to study each case where blocks are to be laid, and to treat the blocks accordingly. For dry situations the blocks should be well seasoned before treatment and laid in the floor while thoroughly dry. In wet or alternately wet and dry situations dry blocks would give expansion trouble, hence the timber should be green or only semi-air-dry when laid. Even dry interiors are liable to be accidentally subjected to water, however; hence it would seem desirable as a rule to use bituminous fillers instead of sand filler.

Sand cushions were probably a source of trouble in several cases. If there is any vibration, or if the sand is at all liable to shift, a bituminous or cement grout cushion is to be preferred. Sand cushions are also liable to cause uneven floors if the blocks shrink, and it seems likely that many cases of shrinking would not give serious trouble where bituminous filler and bituminous or cement grout cushions are used.

Bleeding caused very little trouble. In dry and very warm situations, where it is most likely to occur, it would be desirable to consider carefully the method of treating and handling the blocks in order to avoid objectionable bleeding.

In a few cases it seems likely that good block should not be used. For example, it should not be used where butter or tobacco products are stored. In some foundries, where hot castings are thrown upon the floor, the blocks have burned through to the foundation. Wood blocks may be objectionable where the soiling or staining of certain classes of merchandise would lower the value, and in one case where used in a tennis court wood blocks were a failure and had to be removed.

Wood block has been found to be very satisfactory in many cases where heavy castings are thrown about or where heavy trucks are moved, and it is liked by workmen because it is warm and easy on their feet.

The replies from the users of wood-block flooring indicate quite strongly that when new wood-block floors are to be laid a careful investigation of all the conditions existing or likely to develop should be made by the manufacturer. The method of treatment and construction of the floor should then be adapted to the special conditions found. If this is not done many cases of dissatisfaction are very liable to develop.

Deflector Gives Direct-Reading of Building Settlements

A direct reading deflectometer was used in determining the cause of the usual initial settlement in buildings being underpinned along the New York subways. This deflectometer was never used in this country before according to Maurice Deutsch, consulting engineer, New York City, who used it to make some original tests of piles on this work in September last year. In consists of a steel tape about ½ in. wide attached to the pile being tested and run vertically up and along a small wheel at the end of a horizontal shaft. At the other end of this shaft an index needle is set and revolves around a calibrated dial marked in millimeters, thus giving very exact indications of pile movement.

Light-Soil Roads Not Suitable for Traffic Unless Surfaced

When highway traffic exceeds 2,000 tons per year on roads constructed of light soil it is time to adopt some form of hard surfacing, according to a statement by A. P. Anderson, highway engineer, in the Reclamation Record. Dragging many of these roads has not the cumulative effects, such as obtain on clay roads, as the only binding power is the capillary moisture lost when the road gets dry. The maintenance must be directed toward retaining the moisture by incorporating with the surface soil some natural binder, such as clay or adobe, or adding some temporary fibrous binder, such as straw or sage brush. In irrigated districts flooding is worth considering, one side at a time, or, where the rate of lateral percolation is rapid, flooding the side ditches.

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Principal Contents

Proper Consistency of Concrete

UNSATISFACTORY concrete will result from the very best of aggregates if they are not properly proportioned. The too prevalent unscientific method of arbitrary selection, at present in general use, would scarcely seem to have been justified even by the added facility with which the work can be constructed.

W. S. Gearhart, Chairman of the Committee on Proportions of Materials and Consistency of Concrete, recently pointed out to the Conference on Road Building held in Chicago that if concrete were specified to withstand certain tension, compression, abrasion and absorption tests, and to be subjected to expert inspection, most of the difficulties and failures from faulty proportioning of aggregates could be removed. The requirements for consistency should be more definitely specified. The present terms used in defining consistency are altogether too indefinite to the ordinary contractor. Consistency could probably best be defined by describing how the concrete should act and the form it should take when deposited.

Until some form of apparatus is devised and a systematic method of inspection established little can be done to overcome the present unsatisfactory consistency specifications. Having concrete too wet should be especially guarded against, since wet concrete gives a material inferior in quality and strength to concrete of a medium or quaking consistency. Experiments with hydrated lime in concrete seem to indicate that it decreases the percentage of voids, produces a more impervious concrete, reduces expansion and contraction under moisture changes, and prevents segregation. In spite of the wonderful progress that has been made in concrete work we are evidently still very considerably in the dark as to its scientific preparation. The report of Mr. Gearhart mentioned above, published elsewhere in this issue gives interesting and valuable information on this important subject.

Advantages of Winter Building

The question of winter building is one that of necessity must be decided by the owner himself, and he is generally not sufficiently informed to take the chance. All kinds of mason work are now carried on successfully at all times during the winter. Buildings of reinforced concrete, depending almost entirely upon concrete for support, are erected in the dead of winter. Mortar will not set as rapidly in winter as in summer, but mortar used in winter will become more durable than mortar used in summer. One reason for this may be that brickwork laid in summer absorbs the moisture from the mortar before it has had time to set.

It is an accepted opinion of the public that contracts for winter work can be let at a lower price than at any other time of the year, all things being normal. It is probable that about 10 per cent. of the cost of the building can be saved if contracts are let during the winter.

The man who erects his building in the winter has the advantage of securing the higher class of workmanship represented by the more competent mechanics who are kept on the pay-roll during that period. Furthermore, as the contractor and architect are not rushed with the same amount of work as in the summer, each can devote more of his individual time to the construction of the building.

All woodwork which enters into the construction of a building is far superior when installed during cold weather, the atmosphere being much dryer than in summer. Much of the moisture in the form of rain, which is absorbed by the rough woodwork during warm weather, becomes snow in winter and is easily cleaned off before any material damage can be done. The moisture absorbed by the rough woodwork in summer will not dry out until some time after the building is completed and decorated. When this moisture dries out floors and partitions often settle, causing cracks and other defects.

One of the greatest objections to summer building is the absorption of moisture from the air by the interior wood finish. This interior finish is one of the most important features of a building, and greater care and skill must be employed in its installation than with any other part of a building. It is always subject to more close inspection as long as a building stands, and it is important that every precaution should be employed to preserve the highest class of workmanship in the building as a whole. The moisture absorbed by the finish woodwork in summer will dry out later and cause joints to open, doors to shrink, panels to crack, and the work to assume the character of a building that literally has been thrown together.

On the other hand, heat is maintained in the building erected in the winter, and, as a result, moisture is kept out and the finish remains in a first-class condition.—The Plumber.

Unloading Stone Economically

Editor, Contract Record:—

One of the most troublesome and expensive problems that confront the Road Superintendent where stone has to be shipped in by rail, is the unloading.

Few men are willing to go in a car, especially on a warm day and shovel stone, and except men are used to the work, not much progress is made. Many devices have been invented to overcome this difficulty, some have been tried out with more or less success. The Toronto and Hamilton Highway Commission have a steam derrick with a Clam Shell Dipper which is fairly successful, but this device is too expensive and not portable enough for county work.

It has occurred to me that a light derrick worked by a Gasoline engine with a Clam Shell Dipper that could be easily taken down and moved from station to station, would be a great help. This device could be set up some distance from the loaded car to give the boom room to work and the crushed stone discharged into the wagon or a bin from which it could be loaded. It is strange that some enterprising firm has not put something of this description on the market. Derricks of all designs and capacity are manufactured by many firms but none I have examined seem to be what is required for this particular work.

Yours truly,
James M. Sheppard,
Road Superintendent.
Queenston, Welland Co.

Gravity Filter System for Drummondville

Messrs. Ouimet & Lesage, engineers, of Montreal, have designed a pumping station and mechanical gravity filter system for the town of Drummondville, P. Q., to replace the present one which has been found inadequate to meet modern conditions. The plans provide for a plant of 1,500,000 U. S. gallons capacity per twenty-four hours, but it is proposed to now install two of the three units, each with a capacity of 500,000 gallons; the existing reservoir will be utilized. The water will be taken from the St. Francis River, and will be automatically purified by filtration, alum solution, and liquid chlorine. The chlorine is to be fed through a Venturi meter into the filtered water. The sedimentation basin will have a capacity of 140,000 gallons, and the clear water basin one of 80,000 gallons. Each filtering unit will be operated by hydraulic valves, the action being on marble tables in front of each unit. The four pumps—two high lift and two low lift—will be driven by electric and gasoline motors, the latter to be used as auxiliary forces. The electric current will be supplied by the Southern Canada Power Company. The pumping station and filtration plant will be of concrete and pressed brick, the buildings being made fireproof as far as possible. The former structure will be heated by a hot water system.

Moldless Concrete Construction

A new phase in Portland cement concrete construction which should prove of practical value to contractors and builders has recently been developed, and many ingenious details of construction have been worked out to take care of practical problems which the contractor encounters on the job. This new plan is the erection of reinforced concrete without the use of forms or molds of any kind; the only special equipment necessary being a few inexpensive gauge strips and tamps. The walls in this construction are made up of concrete panels, molded flat on the ground and confined within light steel channels (known as metal lumber). The channels are held apart by steel rods which also serve to reinforce the concrete. When the panels are assembled, the channels come together back to back, and are easily locked in place. The method of concrete building construction is claimed to be revolutionary in its simplicity, low-cost, and adaptability.

"Ladies Night" in Calgary

The Calgary Branch of the Canadian Society of Civil Engineers held its third dinner of the season at the Palliser Hotel, Thursday evening, February 24th. An innovation was tried at this meeting. It was designated as "ladies night" and all present agreed that it was a success.

After the dinner Dr. J. G. Rutherford, Superintendent of Agriculture and Animal Industry, C. P. R., Department of Natural Resources, addressed the Branch on the subject "Some Thoughts on the Present World Situation."

In his remarks the speaker referred to the remarkable development in the world during the past hundred years, which might justify one in saying that the world as we know it is not more than a hundred years old.

Within that time there had been the wonderful spread of transportation facilities, the development of the lighting system and the spread of education, for about one hundred years ago the number of people who could read and write was about equal to those who could not do so now. Dr. Rutherford first saw the electric light in 1880 and the telephone, which is now in such general use, he first utilized in 1878.

While this development was going on there had been an era of wastefulness which he said would compare to a financial drunken spree. The resources of the country had been wasted and now the penalty must be paid. Had we husbanded our wealth instead of wasting it Canada would have been better prepared for the present struggle.

In the absence of William Pearce, Chairman, A. S. Dawson, Chief Engineer, Department of Natural Resources, C. P. R., occupied the chair.

Toronto Section C. S. C. E.

The regularly monthly meeting of the Toronto branch of the Canadian Society of Civil Engineers will be held in the Society's rooms at the Engineer's Club, 90 King Street West, on Thursday, March 9, at 8 p. m. The work of the Committee appointed in 1915 to suggest desirable changes in, or additions to, the present by-laws will be discussed.

The Clays of Southern Saskatchewan

Canada Well Supplied With an Abundance of High Grade Clays—Suitable for Manufacture of Refractories, Stoneware, White Earthenware, Structural Products

By N. B. Davis*

IN the southern part of the province of Saskatchewan there is located one of the most valuable and extensive clay fields of the Dominion of Canada. From the vicinity of Estevan, westward along the international boundary some two hundred and fifty miles, and north to make a triangular area with the apex west of Moose Jaw, the country is underlain by a series of clays, silts, sands and lignites, comprising what is known to geologists as the Fort Union formation. West of this again, smaller detached areas of this same formation outcrop in those elevated areas known as Boundary Plateau, White Mud River Plateau, and the Cypress Hills.

Although the Fort Union formation is known to generally underlie these areas, the valuable clays are not available everywhere over them. It is only in the escarpments of the plateaus, and in the large river valleys, with their tributary coulees, that good workable sections of the clays are to be found.

The most important beds of this formation, to the clayworker, are the white and grey refractory clays and clayey sands, constituting what are locally known as the "white muds." The white plastic clays are of stoneware character, fusing around cone 15. The more sandy beds are quite refractory, some of them standing up to cone 30.

These refractory clays are followed in importance by yellow calcareous clays and clay silts, which are suitable for common clay ware, such as brick and drain tile; and for mixing with the stoneware clays to reduce the temperature of vitrification in making sewer pipe and hollow block.

Dark grey, brown, and black, gumbo-like clays occur in the same formation, but their drying defects are so bad that they cannot be used without special preliminary treatment, such as the pre-heating practised at Estevan.

Lignite beds of fair quality are here and there associated with the clays, and their economic aspects are of great importance to the future of the clayworking industry. The accompanying sketch map (Fig. 1) shows the general distribution of the clay-bearing Fort Union formation, the important clay outcrops being suitably indicated.

It will be noticed that the largest area includes the elevations known as Wood Mountain and the Dirt Hills, and in the following notes these localities, along with other prominent topographical features, such as the Frenchman Valley, Souris Valley, and Cypress Hills, will be used as headings.

Cypress Hills

The section of clays found in the Cypress Hills is the most complete one in the province. The hill tops are protected at the highest elevations by quartzite gravel, the pebbles of which should prove of value for grinding purposes. Below the gravel there is a great thickness of fine, plastic, greyish white, to mottled red and green clays. They are best exposed near the western end of the hills. Some of these are slightly calcareous. Their working qualities are excellent.

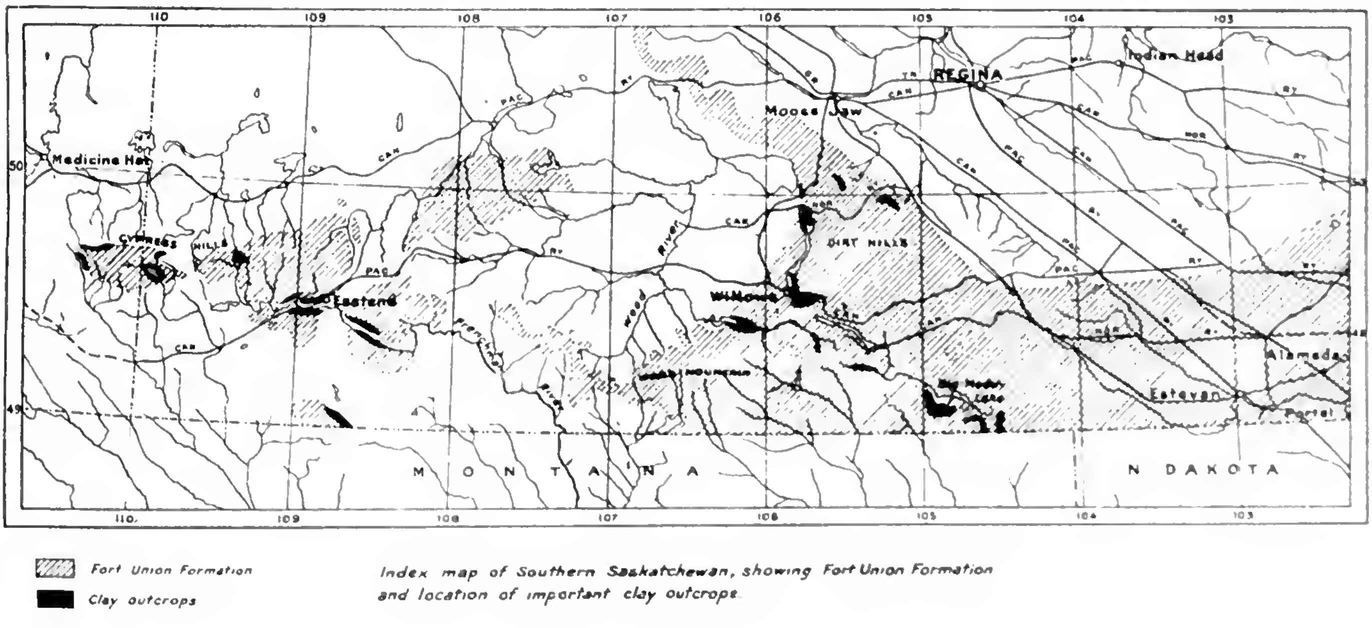
The white refractory clays are not exposed here, but continuing eastward, easily worked outcrops are to be found near old Fort Walsh, on Battle Creek, and in the valley of the White Mud or Frenchman River, the most important locality being the last named.

From Palisade to South Fork the Canadian Pacific Railroad follows the deep valley of the Frenchman River and Swift Current Creek coulee. For most of this distance, some fifteen miles, the white clays can be seen outcropping in the valley sides within a mile or so each side of the railroad.

A typical section measured in the vicinity of Ravenscraig resulted somewhat as shown in Fig. 2.

It will be noted that the white clays are underlain by a considerable thickness of greyish-white quartz

* Mines Branch, Ottawa, before C.N.C.P.A., Toronto.



Index map of Southern Saskatchewan, showing Fort Union Formation and location of important clay outcrops sands, which may prove of value for moulding or glass making.

The yellowish calcareous clays, silts and sands overlying the white clays are quite thick, but erosion has here and there made the white clays available without underground mining operations being necessary.

The beds are all more or less lenticular, all through the Fort Union formation; they thicken and thin from place to place. Along the Frenchman River the good clays appear to increase in thickness eastward, while to the west the beds are more sandy.

In the vicinity of the town of Eastend, where the railroad leaves the valley of the Frenchman River, the best workable outcrops are to be found. To the north and south of the town, erosion has bared considerable quantities of the valuable white clays: in one outcrop the following section was measured: (1) glacial drift, 1 to 10 ft.; (2) brown clay, 8 ft.; (3) fine yellow sand, 2 ft.; (4) plastic white clay, 5 ft.; (5) purplish grey clay, 2 ft.; (6) white plastic clay, 6 ft.

The clays below the glacial drift at this point have good working qualities, with shrinkages within practical limits. They burn to dense, greyish bodies at cone 5, and do not soften until the deformation of cone 15. The Albany slip, Bristol, and salt glazes have been applied, with success, to these bodies.

The glacial clay silt of the valley bottom near Eastend burns to a fine deep red color at cone 010. A small quantity of sand would have to be added to the clay,

Fig. 2—Section of Fort Union Beds near Ravenscraig, Sask.

however, to dry it without cracking. It could then be used for the manufacture of hollow building block and common brick.

Wood Mountain

Between Eastend vicinity and the northwest slope of Wood Mountain the country is heavily covered by glacial deposits, and the Fort Union clays are hidden.

In the coulees tributary to the Wood River and around Twelve Mile Lake the white clays again appear. A sample of a sandy, white clay, collected on the north shore of Twelve Mile Lake, stood up to cone 28.

Further northeast, in the Lake-of-the-Rivers valley, near Willows Station, on the Canadian Pacific Railway, the Alberta Clay Products Company is working a fine section of the refractory clays, and shipping the run-of-bank some 450 miles, via Weyburn and

Fig. 3—Alberta Clay Products Co.'s pit near Willows, Sask.

Moose Jaw, to Medicine Hat. At this place it is worked into sewer pipe, flue-lining, wall coping, etc. Fig. 3 shows the pit being worked during the summer of 1915.

The run-of-bank burns to a dense, vitrified body at cone 9. A sample of a fifteen-foot bed in this section reflects the properties of a ball clay.

Dirt Hills

The white clays appear further north again in the Lake-of-the-Rivers valley, near Mitchellton, on the Canadian Northern Railway, and, again along the north-facing escarpment of the Dirt Hills. It is here at a place called Claybank that the Saskatchewan Clay Products Company is operating the only plant in Saskatchewan, using the refractory white clays.

The plant consists of the usual pit equipment of cars hauled by cable, a large storage shed, one dry pan, one dry press machine, and eight round down-draft kilns. Power is supplied by a 150 h.p. Diesel oil engine. The white, greyish-white and sandy clays are blended to make dry press face brick of plain buff and flashed colors.

Mr. George Shoemaker is manager of the plant, and at present is carrying on experimental work with the intention of placing fire brick on the market, tests on some of the clays having shown them to stand up to cone 30.

Big Muddy Valley

In the Big Muddy Valley, from Willowbunch Lake, southeast to the international boundary, the white clays outcrop here and there all down the valley. The best exposures are located near the boundary line in the vicinity of Big Muddy post office. Tests on a number of samples from this locality show the clays to be in all respects similar to those found in the other areas described.

Souris Valley

East of the Big Muddy Valley, the white clays are not known to outcrop. The whole thickness of the

Fort Union beds consists of dark grey, broken and yellow clays and numerous lignite seams. The best outcrops occur in the Souris Valley, and more particularly in the vicinity of Estevan, where numerous plants are working the red and buff burning clays for making common and face brick, and hollow block. The red burning clay has to be pre-heated to overcome checking, and is then made into dry press bricks.

The industry is fairly well established in the Estevan field, there being some five plants equipped for operation at the present time.

Railroads and Fuel Supply

Until but recently rail transportation has been lacking to the most valuable clay areas. The Portal-Moose Jaw branch of the Canadian Pacific Railway has served the Estevan field for a number of years, but the important refractory clays do not occur there.

Just two years ago the Canadian Northern Railway completed its Avonlea-Gravelbourg branch as far as Claybank in the Dirt Hills, and made the high-grade clays of this locality available. However, the market for high-class face brick broke about the time the railroad arrived, and the plant at Claybank suffered accordingly. During the past year the same Canadian Northern Railroad branch has been constructed west, and made available the clays of the north end of Lake-of-the-Rivers, near Mitchellton.

Three years ago the Canadian Pacific Railway started its Weyburn-Lethbridge line, and since then has tapped the clays of the south end of Lake-of-the-Rivers, and of the White Mud River Valley. The line is now completed as far west as the Alberta boundary, and it is hoped that the time will not be far distant when connection will be made with the construction east from Lethbridge.

South of the Canadian Pacific Railway the Canadian Northern Railway has a branch line extending westward to near the southeast end of Willowbunch Lake. If this line is completed along the proposed route it will open up the clay and lignite areas immediately to the north of Wood Mountain.

At present most of the fuel used is brought in by rail over the Canadian Pacific Railway from Alberta. It is mostly a semi-bituminous coal, and, because of the long haul, the price is high. In the Estevan field a certain amount of the local lignite is utilized, but its full efficiency it not realized.

Extensive tests, carried on at the fuel-testing plant of the Department of Mines, in Ottawa, have shown the lignites to be ideal for making producer gas for power generation in a gas engine. No steaming tests have been made, but the analyses point to its successful application in this way under suitable mechanical conditions.

The gas producer has come to the clay working industry to stay, and the clayworker of Saskatchewan, and the West generally, should not be slow to adopt it as an economical means of converting a poor fuel to a high-grade one.

Natural gas has not been struck, as yet, in commercial quantities anywhere in the southern part of the province. Preparations are being made to sink a well at Eastend in the hope of getting a cheap fuel to aid in the local development of the clays.

The Future of the Clay Industry

The importance of the clays of southern Saskatchewan to the whole Canadian West cannot be overestimated. There is an abundance of high-grade clays suitable for the manufacture of refractories, of stoneware, Rockingham ware, and white earthenware, as well as for all varieties of burned clay products for structural purposes.

Before the outbreak of the war in Europe, the immediate future of the clay industry in Saskatchewan promised well. The railroads were spreading lines of transportation over the country, crops were fair, and the Western farmer was beginning to appreciate something better than a sod shack to live in. Lumber had to be hauled great distances, and the price was, accordingly, high. Prairie fires were teaching the builders with wood the value of more fireproof construction. Altogether, the country was ripe for a better supply of burned clay products.

With the war on, needs have not materially changed. Business is simply marking time for a better monetary condition. The country is essentially a farming one, and with wild-boom days over, and the war at an end, normal conditions should soon return.

Proportioning and Mixing Concrete

Better Proportioning of Aggregates and More Efficient Inspection Necessary to Procure Best Results from Concrete—Effect of the Addition of Hydrated Lime

By W. S. Gearhart*

It is the common practice at the present time to proportion materials for concrete roads and streets by the method of "arbitrary selection"; that is, by specifying the number of parts of different ingredients. Although this is one of the most unscientific methods of proportioning materials, its general use has seemed to be justified by the facility with which the work can be handled under existing conditions. But unless the character of the aggregates to be used and the quality of concrete made with the specified proportions of ingredients are carefully determined, this method should not be used, for a 1:2:3 mixture in one case may be identical in quality with a 1:2:4 mixture, or even a 1:2½:5 mixture of another, on account of the variation in size of aggregates.

Proper Mixing

Unsatisfactory concrete will result from the best aggregates if they are not properly proportioned. Therefore a careful investigation of aggregates may mean the difference between the success or failure of the road. The general adoption of a more scientific method of proportioning the materials is very much to be desired.

By specifying that the concrete be of a standard quality which would withstand certain tension, compression, abrasion, and absorption tests, probably similar to paving brick specifications, and then by requir

* Chairman of Committee, before National Conference on Concrete Road Building.

ing high-class expert inspection to eliminate the personal equation as much as possible, and so that frequent field tests could be made, most of the principal objections to the scientific methods of proportioning materials for concrete could probably be eliminated.

Recommendations

The recommendations for the proportions of the several classes of concrete for roads and streets represent the best practice at the present time. However, they should not be used without a thorough appreciation of the defects in the method of arbitrary selection. These recommendations are therefore made with the understanding that the Portland cement used complies with the Standard Specifications of the American Society for Testing Materials; that the fine and coarse aggregates will meet the standard specifications for concrete roads and pavements of the American Concrete Institute for 1914; that the character of these materials and the quality of the concrete made with the specified proportions of these ingredients will be determined by careful tests; and that the coarse aggregate shall consist of sound, hard stone or gravel having a coefficient of wear of not less than ten for one-course construction and for the wearing course of two-course construction; and not less than seven for the base of two-course construction.

One-Course Concrete.—For a one-course concrete pavement the materials should be mixed in the proportion of one sack of Portland cement, two cubic feet of fine aggregate, and three cubic feet of coarse aggregate; and a cubic yard of the resulting concrete in place should contain not fewer than six and eight-tenths sacks of cement.

Two-Course Concrete.—For the base of a two-course pavement the materials should be mixed in the proportion of one sack of Portland cement, two and one-half cubic feet of fine aggregate, and five cubic feet of coarse aggregate; and a cubic yard of the resulting concrete in place should contain not fewer than five and six-tenths sacks of cement.

If the base is to consist of cement and fine aggregate the material should be mixed in the proportions of one sack of Portland cement to not more than four cubic feet of fine aggregate; and a cubic yard of the resulting concrete in place should contain not fewer than eight and two-tenths sacks of cement.

For the wearing course of a two-course pavement the materials should be mixed in the proportion of one sack of Portland cement to not more than two cubic feet of fine aggregate; and a cubic yard of the resulting concrete in place should contain not fewer than eleven and eight-tenths sacks of cement.

Whenever it is economical to do so the materials in the wearing course should be mixed in the proportions of one sack of Portland cement, one and one-half cubic feet of fine aggregate, and two and one-half cubic feet of coarse aggregate which would be retained on a quarter inch mesh sieve and which would pass a three-quarter inch mesh screen, in order to reduce the difference between the expansion and contraction in the base and wearing courses to a minimum.

Hydrated Lime.—Many experiments in concrete road construction have been made recently with hydrated lime added to the concrete in amounts ranging from five to ten per cent. by weight of the cement. Information available at the present time seems to indicate that the addition of a small percentage of some inert material such as hydrated lime may be of value in concrete road construction for it decreases the percentage of voids and produces a more impervious concrete, and reduces the expansion and contraction under moisture changes; but at this time your committee does not feel warranted in making any definite recommendations.

Consistency of Concrete

The terms used in defining the proper consistency of concrete are generally indefinite and to one man may mean one thing and to another something else. The following examples taken from the replies to the inquiries sent out are representative of the present practice:

"Plastic."

"Plastic enough to retain its shape when screeded, and not to be so plastic that a flow of mortar will be produced on the top, or in which any segregation can take place."

"Mixture must be plastic and of such consistency that it can be troweled and will quake slightly under the trowel."

"Concrete wet enough so that it can be worked easily, yet dry enough to retain its shape—a quaking mixture."

"A quaking mixture that can be made even by tamping."

"A quaking mixture which can be struck off with template."

"Like thick cream."

"Such that a light tamping will bring mortar to the surface."

"Wet enough to produce a concrete that will flush readily under light tamping."

"Dry enough to require slight tamping to settle into place."

"Wet enough to settle in flat mass but not to run on subgrade."

"Works easily under template."

"Requires use of hoe to keep concrete moving."

"Wet enough to flow into place with assistance of laborers and work easily under template."

"A concrete which will hold its shape when struck off with a template."

"Holds its shape when struck with template, but such that the materials will not separate."

"A consistency such that concrete can be conveyed and deposited without separation of coarse aggregate from the mortar."

"No excess water to appear after a thorough tamping."

"Consistency such that when walked onto the foot is removed with effort and the remaining hole does not run full of mortar."

Amount of Water

The amount of water necessary to produce the required consistency varies from about six to twelve per cent. by weight, or from fourteen to thirty per cent. by volume of concrete, and from eighteen to thirty-five gallons, or from one hundred and fifty to three hundred pounds per cubic yard of concrete. This great variation is largely due to: the amount of moisture in the aggregates, the character of the materials, and the atmospheric conditions.

Requirements for consistency should be specified in a more definite way than is usual. It is evident, however, that a standard consistency cannot be expressed in terms of the percentage of water used.

The required consistency can probably be expressed in the most satisfactory terms by describing how the concrete acts and the form it takes when thoroughly mixed and deposited on the subgrade. From this it would seem that some laboratory consistency requirements might be worked out; and it is recommended that extensive investigations be made to devise apparatus and a method of testing concrete which may result in establishing some standard consistency. Until such an investigation is made little can be done to overcome the present unsatisfactory consistency specifications.

The objections to mixing concrete too wet should be especially emphasized. There is practically no danger of having the concrete mixed too dry for the workmen soon learn that by using an excess of water the concrete can be mixed with less effort, and handled, placed and finished more readily than when it is of the proper consistency, and this partly accounts for the general practice of mixing concrete for road work too wet.

It is a matter of general observation both in the field and the laboratory that with the same materials, other things being equal, a wet mixture is inferior in quality and strength to concrete of a medium or quaking consistency. The information available to date also indicates that the expansion and contraction of concrete may be materially affected by the amount of water used in the mixing.

Wet, slushy concrete has the further disadvantage of bringing to the surface any small pieces of wood, bark or other light perishable material that may have gotten into the aggregate. This causes unsightly pitting of the surface and necessitates immediate repairs.

The consistency of concrete for road or street work should be such that when deposited from a chute or bucket it will settle in a flat mass, but will not flow on the subgrade. No tamping should be required and no separation of the mortar from the coarse aggregate should occur in handling the concrete or in finishing the surface.

Handsome New Buildings in Montreal

By E. F. Dartnell*

IN Montreal and the immediate vicinity there are many fine buildings either under construction, or just recently completed which are a credit to Canada's largest city. The following are typical.

The new High School on upper University street, completed during 1914 and illustrated as Fig. 1. The building is trimmed with Indiana Limestone and faced with light grey Kittanning vitrified brick of Norman size, these lend themselves remarkably well to the design of the building and show conclusively that excellent artistic effects can be produced by the use of a smooth brick of the one shade, provided the architect bears in mind the texture and color of his material, getting his tones altogether from the light and shade, which has been very successfully carried out in this case. Architects, Messrs. E. & W. S. Maxwell; general contractors, the Geo. A. Fuller Co., Limited.

Almost opposite to the High School, but a little further up the street, is the Wesleyan Theological College, Fig. 2, a handsome building faced with grey, rough textured Caledonian brick, in mingled shades, laid up in Flemish bond. Architects, Messrs. Ross & Macdonald; general contractors, C. E. Deakin, Limited.

The new Southam Office Building, Fig. 3, on Bleury street, recently completed, is a striking, well

* President, Dartnell, Limited, Montreal.

Fig. 1—Montreal High School, University Street, Montreal.

Fig. 2—Wesleyan Theological College, University Street, Montreal.

designed structure, faced with grey Caledonian brick, similar to those used in the Wesleyan College, with white terra cotta trim. Architects, Messrs. D. R. Brown & Hugh Vallance; general contractors, the Atlas Construction Co., Limited.

The Roman Catholic parish of St. Arsene, has recently completed a Presbytery at the corner of Christopher Columbus and Daniel streets, this is faced with a light grey, rough Caledonian brick. Architect, Mr. Zotique Trudel; contractor for brickwork, Mr. Paul Labelle.

The Civic Library at the corner of Montcalm and Sherbrooke (East) streets is shown in Fig. 4. Architect, Mr. Eugene Payette; contractors, Messrs. John Quinlan & Co. This is a very handsome structure. The front is of stone from Queenston, Ont., with a white Kittanning vitrified brick for facings of the rear wings of building.

The Customs Examining Warehouse, on McGill street, built of Nova Scotia sandstone of a light color, is a large and handsome building. In the interior the lining is all of dry pressed buff brick, about a half million of which were supplied from the work of the Toronto Pressed Brick & Terra Cotta Co., of Milton, Ont., for the purpose. The building was designed by the chief architect of the Department of Public Works, Ottawa, with Mr. A. H. Lapierre, of Montreal, as associate architect. The P. Lyall & Sons Construction Co., Ltd., were general contractors. It is the intention of the government, in the near future, to extend the building north along McGill street to Youville square, making the building when completed fully double the size of the present section, and thus have the custom house and examining warehouse under the one roof. This will be a great convenience to those of the public who have business to transact with the

Fig. 3 The Southam Building, Bleury St.

Fig. 4—Montreal Civic Library, Corner of Montcalm and East Sherbrooke.

Customs, as at present the two departments are some distance apart.

The new home for Loyola College, at Notre Dame de Grace, is a handsome group of buildings from the design of Architect W. J. Murray, with whom Messrs. Peden & McLaren are associated. The buildings are faced with a rough textured brick of a reddish-brown

Fig. 5—Residence of J. S. Archibald, Architect, Corner of W. Dorchester St. and Bruce Ave.

color, in many shades, laid up with a wide, white mortar joint. The buildings are situated to the north of the C. P. R. tracks, between Montreal West and Westmount, and will be a conspicuous feature in the landscape. The general contractors are Messrs. Anglins, Limited. A handsome radial buff chimney, erected by H. R. Heinicke, Inc., is included in this group.

In the same neighborhood, but nearer to the city, on Decarie Boulevard, is a Catholic Orphanage from the plans of Mr. Alphonse Piche, architect, with the Deakin Construction Co., Ltd., as general contractors. This will be a prominent building, built of grey Caledonian brick of rough texture.

Mr. J. S. Archibald, of the architectural firm of Saxe & Archibald, has erected a handsome dwelling for himself at the corner of Dorchester West and Bruce streets, Fig. 5. This is of red "Tapestry" brick.

The Sun Life Assurance Co.'s large and imposing office building is built of Granite, with rear walls of grey Kittanning brick. It is situated on the East side of Dominion square, facing the Windsor Hotel. Architects, Darling & Pearson, Toronto; contractors, the P. Lyall & Sons Construction Co., Limited.

The new home of the Liverpool, London & Globe Insurance Co., at the corner of Dorchester street West and Union Avenue is a fine, handsome structure of grey Ohio sandstone. Architects, Messrs. Nobbs & Hyde and Mr. J. Rawson Gardiner, contractors, Messrs. E. G. M. Cape & Co., Limited.

The Royal Victoria Hospital are erecting another large building, which they have been enabled to do through the late Mr. James Ross, who left them a legacy of a half million dollars for the building and equipment of same. Architects, Messrs. Stevens & Lee, with Mr. Kenneth G. Rea, associate; contractors, Messrs. E. G. M. Cape & Co., Limited.

St. Michael's Church at the corner of St. Viateur and St. Urbain Streets, now in course of erection, will be a handsome building, a dull red brick in many shades and of rough texture is being used. This will be one of the first of large Catholic Churches to be built of brick in this Province. Architect, Mr. Beaugrand-Champagne; contractors, The Atlas Construction Co., Limited.

Mineral Production of Canada, 1915

Output of mines largest on record—Ontario stands highest in value 44% of total — British Columbia shows biggest per cent. increase

The following extracts are taken from the annual preliminary report on "The Mineral Production of Canada in 1915" prepared by John McLeish, B.A., Chief of the Division of Mineral Resources and Statistics. The figures for production in 1915, while subject to revision, are based upon direct returns from mine and smelter operators and are fairly complete.

Effect of the War

As a result of the demand created by the war, the metal mining industry has, in 1915, shown the highest production ever recorded and notwithstanding the greatly decreased production of materials of construction, such as cement, clay and stone quarry products, a very large increase is still shown in the total mineral output, over that of the previous year.

The total value of the metal and mineral production in 1915, as shown in the preliminary report presented herein, Table I, was $138,513,750, compared with $128,863,075 in 1914, and $145,634,812 in 1913, the latter being the highest production recorded. The increase in 1915 over 1914 was thus $9,650,675, or 7.49 per cent. but the output is still less than that in 1913 by $7,121,062.

TABLE I.

THE MINERAL PRODUCTION OF CANADA IN 1915.

SUBJECT TO REVISION

Product.		Quantity.	Value.
METALLIC.			$
Antimony	Lbs.	961,040	192,208
Cobalt, metallic	"	211,610	502,388
Cobalt, oxide	"	379,219	
Nickel, metallic	"	55,325	42,193
Nickel, oxide	"	200,032	
Copper, value at 17·275 cents per pound	"	102,612,486	17,726,307
Gold	Ozs.	916,076	18,936,971
Iron, pig, from Canadian ore	*Tons	158,598	1,740,808
Iron ore, sold for export	"	93,444	187,682
Lead, value at 5·60 cents per pound	Lbs.	45,377,065	2,541,116
Molybdenite	"	28,600	28,460
Nickel, value at 30 cents per pound	"	68,077,823	20,423,348
Silver, value at 49·684 cents per ounce	Ozs.	28,401,735	14,088,397
Zinc ore	Tons.	15,553	636,204
Total			77,046,082
NON-METALLIC.			
Actinolite	Tons.	220	2,420
Arsenic, white	"	2,291	141,830
Asbestos	"	113,115	3,491,450
Asbestic	"	25,700	21,819
Chromite (a)	"	11,486	162,618
Coal	"	13,209,371	31,957,757
Corundum	"	262	33,138
Feldspar	"	15,455	59,124
Graphite	"	2,610	121,023
Grindstones	"	2,580	35,768
Gypsum	"	470,335	849,928
Magnesite	"	14,779	126,535
Manganese	"	47	5,460
Mica			81,021
Mineral pigments—			
Barytes	"	550	6,875
Ochres	"	6,248	48,353
Mineral water			118,796
Natural gas	M. cu. ft.	18,319,710	3,300,825
Peat	Tons.	300	1,050
Petroleum	Brls.	215,464	300,572
Phosphate	Tons.	217	2,502
Pyrites	"	296,910	1,028,678
Quartz	"	127,108	205,153
Salt	"	119,900	600,226
Talc	"	11,885	40,554
Tripolite	"	317	12,119
Total			42,755,594
STRUCTURAL MATERIALS AND CLAY PRODUCTS.			
Cement, Portland	Brls.	5,681,032	6,977,024
Clay products—			
Brick: common, pressed, paving			2,341,483
Sewerpipe			795,646
Fireclay, drain tile, pottery, etc			781,071
Kaolin	Tons.	1,300	13,000
Lime	Bush.	4,932,767	1,015,878
Sand and gravel			2,098,683
Sand-lime brick	No.	23,211,802	182,651
Slate	Sq.	397	2,039
Stone—			
Granite			1,634,084
Limestone			2,504,731
Marble and Sandstone			365,784
Total structural materials and clay products			18,712,074
All other non-metallic			42,755,594
Total value, metallic			77,046,082
Grand total, 1915			138,513,750

* Tons of 2,000 pounds.
(a) Additional returns make total shipment: 14,291 tons value $208,718—See "Chromite" in text.

Without attempting to discuss at length the effect of the war upon the Canadian mining industry, it may be remarked that the demand for the metals, copper, lead, nickel and zinc, led to great activity in the operation of the already developed deposits of these metals, and also, later in the year, to the opening up of old and the exploitation of new deposits. The capacities of steel furnaces were taxed to the utmost to meet the demand for shell steel.

The fact that under war conditions it was desirable that our metals should become available for commercial or national use, entirely within the country and that we should be less dependent, even upon a friendly neutral, for their recovery in smelters and refineries has stimulated the development of our smelting and refining operations.

Amongst non-metallic minerals the recovery of benzol and toluol in by-product coke oven operations was a direct result of the war, as was also the activity in the mining and shipment of magnesite and of chrome ores.

Increase or Decrease in Principal Products, 1915

It will be seen from Table II that there has been an increased production in all metals with the exception of silver. The total value of the metallic production in 1915 was $77,046,082 as compared with $59,386,619 in 1914, and $66,361,351 in 1913, the increase

TABLE II.

Increase or Decrease in Principal Products, 1915.

Principal Products.		Increase (+) or Decrease (−) in Quantity.		Increase (+) or Decrease (−) in Value.	
			%	$	%
Copper	Lbs.	+26,876,526	35·49	+ 7,424,701	72·07
Gold	Ozs.	+ 142,898	18·48	+ 2,953,964	18·48
Pig iron	Tons.	+ 130,555	16·67	+ 1,589,963	15·90
Lead	Lbs.	+ 9,039,300	24·88	+ 914,548	56·19
Nickel	"	+22,559,886	49·56	+ 6,767,967	49·56
Silver	Ozs.	− 48,086	0·17	− 1,505,234	9·65
Total metallic				+17,659,463	29·73
Asbestos and Asbestic	Tons.	+ 21,242	18·07	+ 603,463	20·74
Coal	"	− 428,158	3·14	− 1,514,044	4·32
Gypsum	"	− 46,545	9·90	− 306,279	26·49
Natural gas	M. ft.	− 3,372,794	15·09	− 183,902	5·28
Petroleum	Brls.	+ 659	0·31	− 42,552	12·40
Pyrites	Tons.	+ 68,596	30·04	+ 284,170	38·16
Salt	"	+ 12,862	12·02	+ 106,578	21·59
Cement	Brls.	− 1,491,448	20·79	− 2,210,900	24·06
Clay products				− 2,940,757	32·01
Lime	Bush.	− 2,095,815	28·92	− 344,750	33·94
Sand and Gravel				− 406,628	16·23
Stone				− 964,457	17·63
Total non-metallic				− 8,008,788	11·53
Grand total				+ 9,650,675	7.49

over 1914 being nearly 30 per cent., and that over 1913 the highest previous year, about 16 per cent. The production of nickel, copper and zinc are the highest that have been recorded in these metals. The quantity of nickel was 50 per cent. greater than in 1914, copper over 35 per cent. greater, lead nearly 25 per cent. greater, gold over 18 per cent. and pig iron nearly 17 per cent. The falling off in silver was only 48,000 ounces or less than two-tenths of one per cent. Owing to the high prices of copper and lead the total values of these metals show increases of 72 per cent. and 56 per cent. respectively.

Compared with 1914 the average price of copper shows an increase of 27 per cent., lead an increase of 27 per cent., spelter an increase of 154 per cent., antimony (ordinaries) an increase of 246 per cent., silver a decrease of 9.4 per cent. and tin an increase of 12.2 per cent.

Metal Prices

The total value of the non-metallic production in 1915 including clay and quarry products, etc., was $61,467,668 as against $69,476,456 in 1914; $79,273,461 in 1913. Compared with 1914 the decrease was $8,008,788, or 11.5 per cent., while compared with 1913 the falling off was $17,805,793 or 22.5 per cent.

It will be seen that the largest decreases in 1915 occurred in materials of construction such as cement, clay products, lime, sand and gravel, and stone and quarry products, the falling off varying from 16 to nearly 34 per cent. There was, however, also a smaller production of coal, natural gas and gypsum. On the other hand there were increases in the shipments of asbestos, chromite, graphite magnesite, pyrites and salt.

TABLE III.

Metal Prices.

—		1910.	1911	1912.	1913.	1914	1915
		Cts.	Cts.	Cts.	Cts.	Cts.	Cts.
Antimony (ordinaries)	Per lb.	7·386	7·540	7·760	7·520	8·763	30·280
Copper, New York	"	12·738	12·376	16·341	15 269	13·602	17·275
Lead "	"	4·446	4·420	4·471	4 370	3 862	4 673
" London	"	2·807	3·035	3·895	4 072	4 146	4·979
" Montreal*	"	3·246	3 480	4·467	4·659	4·479	5·600
Nickel, New York	"	40·000	40·000	40·000	40 000	40·000	45·000
Silver, "	Per oz.	53·486	53·304	60 835	59·791	54·811	49·684
Spelter, "	Per lb.	5·520	5·758	6 943	5·648	5·213	13 230
Tin, "	"	34 123	42·281	46·096	44 252	34 301	38 500

*Quotations furnished by Messrs. Thomas Robertson & Company, Montreal, Que.

Ontario again has the largest output with a value of $61,800,178, or 44.6 per cent. of the total, and showing an increase over 1914 of $8,765,501, or 16.5 per cent. British Columbia occupies second place with a value of $28,932,658, or 20.9 per cent. of the total and showing an increase of $4,768,619, or 19.7 per cent. over 1914; Nova Scotia is third with a production valued at $18,126,672, or 13.1 per cent. of the total and showing an increase of $542,033, or 3.1 per cent. over 1914. Quebec comes fourth with a value of $12,159,436, or 8.8 per cent. of the total, and an increase over 1914 of $322,507, or 2.7 per cent. Alberta occupies fifth place with a production of $9,915,282, or 7.2 per cent. of the total and showing a decrease of $2,768,952, or 21.8 per cent. compared with 1914. The Yukon district mineral production including copper and coal as well as gold, is sixth, with a value of $4,915,863, or 3.6 per cent. of the total and a falling off from 1914 of $502,322, or 9.3 per cent. Manitoba's production was $1,351,604, a falling off of $1,061,885, or 44 per cent. New Brunswick's production was $916,329, a decrease of $98,241, or 9.7 per cent. and the production of Saskatchewan was the smallest, being $395,728, or less than that of 1914 by $316,585, or 44.4 per cent.

Gold

The total production of gold in placer and mill bullion and in smelter products in 1915 is estimated at 916,076 fine ounces valued at $18,936,971, as compared with 773,178 fine ounces valued at $15,983,007 in 1914, an increase of $2,953,964 or 18.5 per cent. Although the production has more than doubled since 1907 it has not yet reached the high mark attained during Klondike's best years.

Of the total production in 1915 about $5,550,987 was derived from placer and alluvial mining, $9,195,307 in bullion and refined gold and $4,230,677 contained in matte, blister copper, residues and ores exported.

The production in Nova Scotia was about $137,178, or over twice the output of the previous year. The pyrites ores of Quebec carry small quantities of gold and silver though the producers are not paid therefor. No placer recovery was reported from this province.

Ontario has now become the largest gold-producing province in Canada, the production in 1915 from fifteen properties being reported as $8,386,956, or 44 per cent. of the total production in Canada, as against a production in 1914 of $5,545,509 an increase of $2,841,447, or 51 per cent. The Hollinger and Acme Mines contributed about one-half of the output in 1915 and the Dome nearly one-fifth of the total.

The exports of gold bearing dust, nuggets, gold in ore, etc., in 1915 are reported by the Customs Department at $16,528,143.

Silver

The production of silver was 28,401,735 ounces valued at $14,088,397 as against 28,449,821 ounces in 1914, valued at $15,593,630. Silver is the principal metal that did not show an increased production in 1915. The falling off in quantity was very small however amounting to only 48,086 ounces. Owing to the lower price of silver the decrease in total value was $1,505,234 or over 9.6 per cent.

Of the total production in 1915, 24,653,057 ounces, or about 86.8 per cent. is credited to Ontario.

The exports of silver bullion and silver in ore, etc., as reported by the Customs Department, were:— 27,672,481 ounces valued at $13,812,038.

The price of silver in New York varied between a minimum of 46¼ cents in September and a maximum of 56 cents in December, averaging for the year 49.684 cents, a decrease of 5.127 cents from the average price in 1914.

Copper

The copper output in 1915 was the highest recorded. The production in smelters together with the estimated recoveries or amounts paid for in ores exported amounted to 102,612,486 pounds which at the average New York value of refined copper would be worth $17,726,307. The highest previous production was in 1912 when an output of 77,832,127 pounds was reached. Compared with the production in 1914 which was 75,735,960 pounds valued at $10,301,606 an increase is shown of 26,876,526 pounds or 35 per cent. and in total value of $7,424,701, or 72 per cent.

TABLE IV.

Mineral Production by Provinces, 1914 and 1915.

	1914		1915.		Increase (+) or Decrease (−).		
	Value of Production.	Per cent of total.	Value of Production.	Per cent of total.			
	$	%	$	%		$	%
Nova Scotia	17,584,639	13 65	18,126,672	13 09	+	542,033	3 08
New Brunswick	1,014,570	0 79	916,329	0 66	−	98,241	9 68
Quebec	11,836,929	9 21	12,159,436	8 78	+	322,507	2 72
Ontario	53,034,677	41 01	61 800,178	44 62	+	8 765,501	16 53
Manitoba	2,413,489	1 88	1,351,604	0 97	−	1,061,885	44 00
Saskatchewan	712,313	0·55	395 728	0 28	−	316,585	44 44
Alberta	12,684,234	9 87	9,915,282	7 16	−	2,768,952	21 83
British Columbia	24,164,039	18 80	28,932,658	20·89	+	4,768,619	19 73
Yukon	5,418,185	4 21	4,915,863	3 55	−	502,322	9 27
Dominion	128,863,075	100 00	138,513 750	100 00	+	9 650 675	7 49

The New York price of electrolytic copper rose from a minimum of 13 cents per pound in January to 20 cents in June, falling again to 16 cents in August, then rising steadily to the end of the year, reaching a maximum of 22 cents at the end of December. The average monthly price for the year was 17.275 cents, as compared with an average of 13.602 cents in 1914, an increase of 3.673 cents, or 27 per cent. This is the highest average monthly price since 1907, when 20.004 cents per pound was reached.

Exports of copper according to Customs records were; copper fine in ore, etc., and copper in pigs 102,729,579 pounds valued at $12,460,356, there were also exports of old and scrap copper amounting to 4,161,600 pounds valued at $616,553.

The total value of the imports of copper in 1915 are recorded as $3,467,586 as against $4,256,901 in 1914. The imports in 1915 included 16,818,116 pounds of copper in pigs, ingots and manufactures, valued at $3,104,382; other manufactures valued at $263,922, and copper sulphate 1,854,850 pounds, valued at $99,282.

The imports in 1914 included 26,280,815 pounds crude and manufactured copper valued at $3,983,322, copper sulphate 1,143,039 pounds valued at $53,802 and other manufactures of copper valued at $219,777.

Nickel

Refined metallic nickel is now being recovered in Canadian refineries but only in small quantities and as a by-product in the smelting and refining of the silver-cobalt-nickel ores of the Cobalt district, nickel oxide having been recovered in these smelters for several years. The nickel-copper ores of the Sudbury district supplemented by a small tonnage of similar ores from the Alexo mine in Timiskaming, north of Cobalt are the main sources of nickel production which in 1915 increased nearly 50 per cent. as compared with 1914 and is greater than the production in 1913, the largest previous record, by over 37 per cent.

TABLE V.

Production of Nickel in Canada.	1911	1912.	1913.	1914.	1915.
	Tons.*	Tons.*	Tons.*	Tons.*	Tons.*
Ore mined	612,511	737,584	784,697	1,000,364	1,364,048
Ore smelted	610,834	725,065	823,403	947,053	1,272,283
Bessemer matte produced	32,607	41,925	47,150	46,396	67,703
Copper content of matte	8,966	11,116	12,938	14,448	19,608
Nickel " "	17,049	22,421	24,838	22,759	34,039
Spot value of matte	$4,945,592	$6,303,102	$7,076,945	$7,189,031	$10,352,344
Exports of Nickel from Canada.	1911. Lbs.	1912. Lbs.	1913. Lbs.	1914. Lbs.	1915. Lbs.
Nickel contained in matte, etc.—					
Exported to Great Britain	5,023,393	5,072,867	5,164,512	10,291,979	13,748,000
Exported to United States	27,596,578	39,148,993	44,224,119	36,015,642	52,662,400
Exported to Other Countries	....	....	70,386	220,706	....
	32,619,971	44,221,860	49,459,017	46,538,327	66,410,400

Imports of Nickel into United States	1911.	1912.	1913	1914	1915(a)
Gross tons of ore and matte....Tons.	23,993	33,101	37,623	29,564	41,053
Nickel contents. ....Lbs.	29,545,967	42,168,769	47,194,101	35,006,700	50,099,707
Exports of Nickel from United States—					
To France....Lbs.	5,463,358	5,083,947	3,631,858	3,457,157	2,749,554
To Netherlands.... "	9,101,150	7,387,447	6,622,811	855,168	52,770
To United Kingdom .... "	7,196,259	8,191,364	8,221,640	10,836,369	13,570,574
To other Countries.... "	3,338,819	5,152,258	10,096,779	12,446,458	8,130,687
Total.... "	25,099,586	25,815,016	29,173,088	27,595,152	24,503,585

* In tons of 2,000 lbs. (a) Eleven months only.

The exports of nickel are reported by the Customs Department as 66,410,400 pounds valued at $7,394,446 or an average of 11.13 cents per pound. Since about 80 per cent. of the Canadian nickel production is exported to the United States, it may be of interest to add to the Canadian statistics a record of the imports (eleven months only in 1915) of nickel into and the exports from the United States.

The exports of nickel from the United States during the eleven months ending November were 24,503,585 pounds valued at $9,299,234 or an average of 37.95 cents per pound. More than 50 per cent. of these exports went to the United Kingdom. The value of the United States exports in 1914 ranged from 31 to 39 cents per pound and averaged about 34 cents.

It will be noted that a larger quantity of nickel finds its way to the United Kingdom through United State's refineries than is exported directly from Canada.

The price of refined nickel in New York remained fairly constant during the first seven months of the year, quotations published by the Engineering and Mining Journal being 40 to 45 cents per pound for ordinary forms with 5 cents per pound more asked for electrolytic metal. During the last five months of the year prices ranged between 45 and 50 cents for ordinary forms.

Lead

Although there was an increase of nearly 25 per cent. in the production of lead the 1915 output has been exceeded in six of the past 15 years. The production of lead in 1915 was 45,377,065 pounds, which valued at 5.60 cents per pound, the average price of pig lead in Montreal for the year, would be worth $2,541,116. The production in 1914 was 36,337,765 pounds valued at $1,627,568, or an average of 4.479 cents per pound. The 1915 production consists chiefly of pig and manufactured lead produced at Trail, B. C., but includes also an estimate of the lead probably recoverable from ores shipped to smelters outside of Canada. The entire output of the Surprise mine in the Slocan District, B. C., was shipped to the United States, refined in bond, and sold in London.

The exports of lead in ore, etc., in 1915 are recorded by the Customs Department as 1,845,100 pounds valued at $40,273, and of pig lead 2,066,929 pounds valued at $79,067. Exports in 1914 were 246,100 pounds of lead in ore and 510,573 pounds of pig lead.

The total value of the imports of lead and lead products in 1915 was $2,479,261 as against $1,042,538 in 1914.

The average monthly price of lead in Montreal varied between a minimum of 4.27 cents in January and a maximum of 6.61 cents in December, averaging for the year 5.60 cents.

The average monthly price of lead in New York was 4.628 cents and in London £22.917 per gross ton, equivalent to 4.979 cents per pound.

Zinc

Complete returns of zinc shipments have not yet been received but the tonnage is estimated at 15,553 tons containing 12,400,000 pounds of zinc. Shipments include several hundred tons from Notre Dame des Anges, Quebec, but the greater part is from fifteen properties in British Columbia. Zinc shipments in 1914 were reported as 10,893 tons containing 9,101,460 pounds of zinc.

The price of spelter in New York varied between a minimum of 5¾ cents per pound in January and a maximum of 25 to 27 cents in June, the price at the close of the year being from 15¼ to 16¾ cents and the average for the year 13.230 cents per pound.

The price of high-grade spelter rose from 10 cents at the beginning of the year to over 40 cents in midsummer and was maintained fairly strongly through the balance of the year at from 35 to 40 cents.

Antimony

After several years of no production the demand and high prices in 1915 caused a renewal of activity in mining antimony ores at West Gore, Nova Scotia, and Lake George, New Brunswick. About 1,288 tons of concentrates were shipped to England from the former locality. The total production reported is estimated at about 961,040 pounds of antimony refined and in concentrates.

The recorded exports of antimony ore in 1915 were 1,149 tons valued at $82,990, while the imports included antimony or regulus of, etc., 1,962,194 pounds valued at $344,918 and antimony salts 67,956 pounds valued at $10,320.

The price of antimony, ordinary grades, in New York ranged between a minimum of 13 cents in January to a maximum of 42 cents in December, averaging about 30 cents for the year.

Cobalt

Metallic cobalt is now being recovered as well as cobalt oxide at the smelters at Deloro and Thorold. The silver-cobalt-nickel ores of the Cobalt district are reduced in these smelters, silver being the principal product with arsenious oxide, metallic cobalt and nickel, cobalt oxide and nickel oxide as by-products. Returns received showed a production in 1915 of 211,610 pounds of metallic cobalt and 379,219 pounds of cobalt oxide, equivalent to a total of 477,063 pounds of metal. In 1914 the production was reported as 899,027 pounds of cobalt oxide and 242,572 pounds of cobalt contained in residues sold outside of Canada or equivalent to a total of 871,891 pounds of cobalt.

Molybdenum

A production has been reported of about 28,600 pounds of molybdenite valued at $28,460, including cobbed molybdenite and molybdenite contained in ore shipped to concentration plants. There were also about 50 tons of low-grade ore sent to the Mines Branch Ore Testing laboratories for experimental concentration.

Platinum

Efforts are being continued to recover platinum from the gravels on the Tulameen river in the Similkameen district of British Columbia and there is also occasional recovery of small quantities from the gold gravels of Quesnel division, Cariboo district. A recovery of about 20 ounces is reported in 1915. There was no recovery of platinum from the Sudbury nickel-copper mattes.

Customs records show an export of platinum of 236 ounces valued at $11,052, but this may possibly include old metal.

The price of refined platinum in New York which was about $41 per ounce in January fell to $38 in June and July, but increased to an average of $85.50 in December. The year's average was about $47.

Iron Ore

Iron ore shipments in 1915 amounted to 398,112 short tons valued at $774,427 as compared with 1914 shipments of 244,854 short tons valued at $542,041.

Mine operators report 93,444 tons of ore exported to the United States and 304,668 tons shipped to Canadian furnaces.

According to the records of the Customs Department exports of iron ore amounted to 79,770 tons valued at $206,823 and imports of iron ore to 1,499,722 tons valued at $2,320,066.

Pig Iron

The total production of pig iron in Canadian blast furnaces in 1915 was 913,719 short tons, valued at approximately $11,592,819 as compared with a production of 783,164 short tons in 1914 valued at approximately $10,002,856. The 1915 output shows an increase of 130,555 tons or 16.67 per cent. over that of 1914, and compares favorably with the average of recent years.

Of the total production in 1915, 13,692 tons were made with charcoal and 900,027 tons with coke.

Included in the ore charged to blast furnaces there was 293,305 short tons from Canadian mines and 1,463,681 tons of imported ore. Of the imported ore naces of 10,794 tons of ferro-alloys (chiefly ferro-sili-

There was also in 1915 a production in electric furnaces of 10,794 tons of ferro-alloys chiefly ferro-silicon with a very small tonnage of ferro-phosphorus) valued at $753,406 as compared with a production in 1914 of 7,524 tons valued at $478,355.

The exports during 1915 of pig iron were 17,307 short tons valued at $231,551 or an average per ton of $13.38, and of ferro-silicon and ferro-compounds 9,238 tons valued at $537,081, an average of $50.81 per ton, or a total of 26,545 tons valued at $768,632 as compared with a total in 1914 of 19,063 tons valued at $486,366. The imports were 47,482 tons of pig iron valued at $624,200, or an average of $13.15 per ton, and 13,758 tons of speigeleisen, ferro manganese and ferro-silicon valued at $807,312, or a total of 61,240 tons valued at $1,431,512.

Steel Ingots and Castings

The production of steel ingots and castings in 1915 including 5,626 tons from electric furnaces, was 1,020,335 short tons, as compared with a production in 1914 of 828,641 tons. The 1914 production included open-hearth ingots 608,383 tons; bessemer ingots 203,184 tons; direct open-hearth castings 15,315 tons; and other steel castings 1,759 tons.

Asbestos

The asbestos production in 1915 was obtained from the same field in Quebec as heretofore. The output was less than in 1914, but sales showed an increase of about 17 per cent. Stocks on hand at the end of the year showed a noticeable decrease.

The total output in 1915 was 106,558 tons, as against 107,668 tons in 1914, showing a decrease of 1,110 tons or 1.03 per cent. The sales and shipments during 1915 were 113,115 tons valued at $3,491,450, or an average of $30.87 per ton, as against sales in 1914 of 96,542 tons valued at $2,892,266 or an average of $29.92 per ton. The total sales were larger in quantity than those of 1914 by about 17 per cent. and in value by about 20 per cent.

Exports of asbestos during the calendar year 1915 were 84,584 tons valued at $2,734,695 or an average of $32.45 per ton, as against exports of 81,081 tons in 1914 valued at $2,298,646 or an average of $28.35 per ton. There was also an export of asbestos sand amounting to 25,103 tons valued at $157,410 or an average of $6.27 per ton and of manufactures of asbestos valued at $125,003.

Imports of asbestos manufactures for the year amounted to $168,894.

Coal

The total production of marketable coal for the year 1915 (comprising sales and shipments, colliery consumption, and coal used in making coke, or used otherwise by colliery operators), was 13,209,371 short tons valued at $31,957,757, as against 13,637,529 tons valued at $33,471,801 in 1914 showing a decrease of 428,158 tons, or 3.14 per cent. in quantity, and of $1,514,044 or 4.52 per cent. in total value.

The exports of coal in 1915 were 1,766,543 tons valued at $5,406,058 as compared with exports of 1,423,126 tons in 1914 valued at $3,880,175, an increase of 343,417 tons or 2.41 per cent.

The imports of coal in 1915 were made up as follows: bituminous round and run of mine: 6,106,794 tons, valued at $7,564,369, or an average of $1.24 per ton, bituminous slack 2,286,916 tons valued at $2,027,256, or an average of $0.89 per ton, and anthracite 4,072,192 tons valued at $18,753,980 or an average of $4.61 per ton, making a total of 12,465,902 tons valued at $28,345,605.

The apparent consumption of coal during 1915 was 23,849,040 tons, as against a consumption of the previous year of 26,852,323 tons. Canadian mines contributed 48 per cent. of the domestic consumption, and the balance was imported. The total Canadian production was equivalent to about 53.4 per cent. of the consumption.

Coke

The output of oven coke during 1915 was 1,200,766 short tons made from 1,856,393 tons of coal of which 1,425,172 tons were of domestic origin, and 431,221 tons were imported. The total quantity of coke sold, or used by the producers during the year was 1,168,921 tons valued at $4,253,536 or an average of $3.64 per ton.

In 1914 the total output was 1,015,253 tons, and the quantity sold, or used by the producers, was 1,023,860 tons valued at 3,658,514 or an average of $3.57 per ton.

By-products from coke ovens which included 10,448 tons of ammonium sulphate, 7,365,931 gallons of tar, and 4,089,602 thousand cubic feet of gas, made in 1915 were in excess of the production in 1914; there was also for the first time a production of benzol and associated compounds. The production of trinitrotoluene near the close of the year was reported by Col. Carnegie of the Shell Committee, as 110,000 pounds per week.

Imports of coke during 1915 amounted to 637,857 tons valued at $1,608,464, and exports were 35,869 tons valued at $160,053.

Other Non-Metals

Graphite: Shipments of milled and refined graphite amounted to 2,610 tons valued at $121,023 or an average of $46.37 per ton. The 1914 production was 1,647 tons valued at $107,203. Operators report a greatly increased demand with higher prices owing to the shortage in supplies in the United States from sources outside of America.

Gypsum: The production of gypsum of all grades in 1915 is reported as 470,335 tons valued at $849,928. This is lower than for several years, previous production having been 516,880 tons in 1914; 636,370 tons in 1913; and 578,454 tons in 1913.

Exports of crude gypsum were 292,234 tons valued at $336,380 being the smallest reported since 1908. Exports of ground gypsum which were valued at less than $10,000 yearly for many years rose to a value of $35,490 in 1914 and to a value of $80,933 in 1915.

Magnesite: The production of magnesite in 1915, chiefly crude but including some calcined, was 14,779 tons valued at $126,535 in contrast with a yearly average production from 1908 to 1914 inclusive of 621½ tons. The increased production was due largely to the urgent demands of steel companies and manufacturers of refractory brick.

Manganese Ores: In 1915 there was according to returns received to date, a production of 47 tons of manganese ore (90 per cent. MnO_2) valued at $5,460 or an average of $116.17 per ton, as compared with a production in 1914 of 28 tons, valued at $1,120 or an average of $40.00 per ton.

The records of the Customs Department show exports of manganese ores amounting to 255 tons, valued at $6,855, which would seem to indicate shipments additional to those reported.

Natural Gas: The 1915 production of natural gas was approximately 18,319,710 thousand cubic feet valued at $3,300,825.

The production of the previous year was reported as 21,692,504 thousand cubic feet valued at $3,484,727.

Pyrites

The production of pyrites in 1915 was 296,910 tons valued at $1,028,678. The 1914 production was 228,314 tons valued at $744,508.

Exports of pyrites in 1915 were 137,598 tons valued at $527,318, or an average of $3.83 per ton, as compared with exports in 1914 of 89,888 tons valued at $377,985, or an average of $4.21 per ton.

Cement

The general decrease in production of structural materials and clay products which was a feature in 1914 was repeated in 1915, the production in the latter year being valued at $18,712,074, as against a production in 1914 valued at $26,009,227.

The total quantity of Portland cement, including natural Portland, made in 1915 was 5,153,763 barrels of 350 pounds each, as compared with 8,727,269 barrels in 1914, a decrease of 3,563,506 barrels, or about 40 per cent.

TABLE VI.

Production and Sales of Portland Cement.

	1912.	1913	1914.	1915
	Brls.	Brls.	Brls.	Brls.
Portland Cement sold or used	7,132,732	8,658,805	7,172,480	5,681,032
" manufactured	7,141,404	8,886,333	8,727,269	5,153,763
Stock on hand Jan. 1st	894,822	862,067	1,073,328	2,620,022
" Dec. 31st	903,094	1,089,595	2,628,117	2,062,961
Value of cement sold or used	$ 9,106,556	$11,019,418	$ 9,187,924	$6,977,024
Wages paid	$ 2,623,902	$ 3,466,451	$ 2,271,006	$ 1.180,882
Men employed	3,461	4,276	2,977	1,679

Consumption of Portland Cement.

Calendar Year.	Canadian.		Imported.		Total.
	Barrels.	Per cent.	Barrels.	Per cent.	Barrels.
1911	5,692,915	90 0	661,916	10.0	6,354,831
1912	7,132,732	83·3	434,413	16·7	8,567 145
1915	8,658,805	97·1	254,093	2·9	8,912,988
1914	7,172,480	98·7	98,022	1·3	7,270 502
1915	5,681,032	99·5	28,190	0·5	5,709,222

The total quantity of Canadian Portland cement sold or used during 1915 was 5,681,032 barrels, valued at $6,977,024 or an average of $1.228 per barrel, as compared with 7,172,480 barrels, sold or used in 1914, valued at $9,187,924, or an average of $1.28, showing a decrease in quantity of 1,491,448 barrels, or about 20 per cent.

The total imports of cement in 1915 were 98,664 cwt. equivalent to 28,190 barrels of 350 pounds each, valued at $40,426, or an average of $1.434 per barrel, as compared with imports of $98,022 barrels, valued at $147,158, or an average of $1.50 per barrel in 1914.

The total consumption of cement, therefore, neglecting a small export, was 5,709,222 barrels, as compared with a consumption of 7,270,502 barrels in 1914, showing a decrease of 1,561,280 barrels, or about 21 per cent.

The average price per barrel at the works in 1915 was $1.228 as compared with $1.28 in 1914, $1.27 in 1913, $1.28 in 1912, and $1.34 during 1911 and 1910.

The imports of cement in 1915 included 1,065 barrels, valued at $1,480 from Great Britain, and 27,125 barrels, valued at $38,946, from the United States.

Welland and Georgian Bay Canals

Economic and Strategic Aspects of Enlargement of Welland Canal and Construction of Georgian Bay Canal

By R. W. Leonard, M. C. S. C. E.*

This is a most important subject for debate by the Canadian Society of Civil Engineers, because it involves vitally the probability of continued existence of our international boundary, as well as the question of the economic expenditure of vast sums of money, and because it is a question that should be solved by civil engineers.

Internationally, the question involves the use of constricted water-ways at Sault Ste. Marie, St. Clair River, Detroit River, Welland Canal and St. Lawrence River by both peoples, some of which water-ways are on one side of the boundary and some on the other, and the effect of such a condition in case of friction unhappily arising between Canada and the United States.

Commercially, the economics of the projects can be compared with transportation by rail and with one another. The expenditure involved and where it is spent, and the effect of the expenditure upon the country as a whole, are most important.

Civil engineers alone can make the surveys and determine the physical possibilities of construction, the cost of construction, and the relative engineering advantages or disadvantages in the construction, maintenance and operation, as compared with railway transportation on the one hand, and the one canal project with the other on the other hand.

This question is apparently of such wide scope, and involves technical detailed knowledge of so great variety that the writer submits it affords ground for much valuable discussion, which it is to be hoped will be elicited by this paper, contributed with diffidence but in good faith by the writer as his view.

Canal Systems

The present canal systems of commercial importance consists of:—

(1) Sault Ste. Marie Locks:—one on the Canadian side 900 ft. x 60 ft. x 19 ft. draft, one on the United States side 600 ft. x 100 ft. x 14 ft. draft, one on the United States sides 800 ft. x 100 ft. x 19 ft. draft, one on the United States side 1,250 ft. x 80 ft. x 24½ ft. draft, opened October 21, 1914, one on the United States side expected to be ready shortly

(2) Channels in United States territory below locks in Sault.

(3) Channels in Canada and United States in St. Clair River.

(4) Channels in Canada and United States in Detroit River.

(5) Welland Canal, including 24 locks, 270 ft. x 45 ft. x 14 ft. draft.

(6) St. Lawrence canal system, 26 locks, 270 ft. x 45 ft. x 14 ft. draft.

After the War of 1812 the British Government recognizing the necessity of having a line of communication for military purposes away from the boundary—canalized the Ottawa River from Montreal to Ottawa, and the Rideau and Cataraqui Rivers from Ottawa to Kingston for barges drawing five feet of water at a cost of $3,911,700, which system they subsequently gave to Canada free of cost.

The Department of Railways and Canals has since nearly completed the Trent canal system from Trenton on Lake Ontario to Georgian Bay, for barges drawing about five feet of water at a cost to date (1914) of $13,611,035, exclusive of interest.

These last two systems—however interesting to the summer tourist as canoe and yachting routes—are not of great economic or strategic importance under modern conditions.

The cost, maintenance, operation and repairs for the year 1913 being $309,822.65, and the tonnage passing through (mainly pleasure boats, cord wood, lumber and sand) amounted to 227,023 tons.

Ottawa-French River Route

About 1904 the Dominion Government (Public Works Department) started a survey of the Ottawa-French River route for the purpose of arriving at the cost of a 22 ft. ship canal. The result is embodied in a very voluminous report, dated 1908, including estimates as follows:—

Total length of canal .... 440 miles, including:—	
Free navigation	346 miles
Improved channels	66 miles
Excavated canal	28 miles
Total	440 miles, 22 ft. deep.
Costing	$100,000,000.00

The system is estimated to be capable of developing 1,000,000 h.p. on the direct canal route, and this estimate might probably be doubled by figuring the power developed in regulating the tributary streams.

It is significant that about the same time the Department of Railways and Canals commenced to make surveys to determine the possibility of enlarging the Welland Canal from the present 14 ft. draft to 30 ft. draft. These surveys were completed in 1913 and the parliamentary estimate for that year included $2,000,000.00 for the enlargement of the Welland Canal and $500,000.00 for canalizing the French River from Georgian Bay to Lake Nipissing.

The total estimate of the cost of enlarging the Welland Canal (26 miles) is reported to be $50,000,000.00, probably two-thirds of which is expended in the United States for fuel and machinery, and in various foreign countries in the form of wages sent home by labourers.

The lift of 325 ft. is overcome by 7 locks of 46.5 ft. lift, 800 ft. long x 80 ft. wide x 30 ft. draft.

The St. Lawrence canals enlargement has not been surveyed and no information is therefore available to indicate whether corresponding enlargement to suit that at the Welland Canal is physically possible at any cost of construction, and the people of Canada have not been informed of any treaty with the United States sanctioning such deepening of international waters with the probable construction of international dams, etc.

During 1913-14 contracts were let for the construction of about ten miles of the Welland Ship Canal, in-

* Before Can. Soc. C. E., Montreal

cluding all the locks at a cost of probably $35,000,000.00 and the work of excavation is possibly half done.

Internationally considered, this question is of supreme national importance, as involving such questions as national defence and the very possibility of holding Canada for the Empire.

In this connection, it must be borne in mind that New York State is enlarging the Erie Canal from Troy to Oswego and to Buffalo, from six or seven feet draft to twelve feet with a lock length of 311 feet, and width of 45 feet, to accommodate barges of 1,500 tons capacity, these canals will open Lakes Ontario and Erie to formidable United States war vessels giving them absolute control of these lakes at all times, unless Canada be supplied with similar transport facilities apart from the boundary waters of the St. Lawrence River from Kingston to Prescott.

The enlargement of the Welland Canal will also carry a great preponderance of large United States steel freighters into Lake Ontario, thus giving to that country an undisputed control of that lake.

Canada has enjoyed a century of peace with her powerful southern neighbor, and it is the wish of all good citizens to enjoy another one, even avoiding in the coming century such incidents as the "Trent Affair," the Fenian Raids, Venezuela messages and the Panama canal question, and serious boundary disputes, fishery disputes, international water power questions, etc., to say nothing of United States Senate Reports, 1889-1890 (Testimony of Joseph Nimmo, Jr.), etc. Such questions having arisen in the past, however, they will naturally arise in the future, and the peaceful settlement of them depends largely upon the temper and temptations at the time. So long as an international boundary is to be retained, so long should the policy of Canada be to preserve peace while safeguarding her honor and interests.

Canada's Most Expensive Commercial Problem

It is not apparent to the public that this canal problem (probably Canada's most expensive commercial project under construction) has been considered by the Canadian people from the national point of view, though pamphlets have been published, ad nauseam, by Boards of Trade of various municipalities treating the subject in a spirit of parochial politics, each exaggerating the advantages of one route and the disadvantages of the other, the very apparent incentive in each case being the expenditure of public money on construction in the immediate vicinity of the municipalities interested.

If the question be approached from a purely economic point of view, it is probable that freight (and grain from the prairies to the Atlantic seaboard in Canada is the most important commodity at present) can most cheaply be handled by rail from Winnipeg to Fort William and Port Arthur, by ship to Georgian Bay, and by rail over a direct line with easy gradients to Montreal, than by any canal at present built or proposed. On this route the C. P. R. has a double track from the West to Fort William; the G. T. P. and the C. N. R. have each a single track between the same points. There is a large fleet of United States steamers engaged in the coal, grain and ore trade on the lakes, and the Canadian fleet is growing rapidly. The C. P. R. has a line with easy gradients from Port McNicoll, on Georgian Bay, where it has built large grain elevators, to connect with its Toronto-Montreal line, with a view to carrying grain in competition with the canals, and they probably have estimates of comparative cost warranting the expenditure, even under the unequal conditions that the traffic by the railway must pay interest, depreciation and upkeep, while the Government assumes these enormous sums in the case of the waterways making the canals free to all ships alike, Canadian and foreign.

Water Transportation Regulates Freight Rates

The people are educated to demand water transportation "to regulate rail freights," and to what extent a larger canal than the present 14-foot Welland-St. Lawrence system will result in a reduction of rates is a question that can be figured in many different ways with varying results. Figures have been prepared by competent authorities showing that the maximum saving in freight on wheat from Fort William to Montreal by the enlargement of the Welland Canal will be ⅜c. per bushel, which will amount to $187,500.00 per year on 50,000,000 bushels—at a cost in interest on $50,000,000.00 of say $2,000,000.00 per year plus depreciation, upkeep and operation.

Return cargoes of coal are obtained in Lake Erie ports. Probably few will contend that 14 ft. draft ships are not economical for package freight from Lake Ontario or St. Lawrence points.

It will be of interest in this connection to have a report on the feasability and cost from an engineering point of view of lengthening the existing locks on Welland and St. Lawrence canals 100 ft., and the economic results of such lengthening if it be practicable.

To analyse and compare the respective advantages and disadvantages of these two routes.

Assuming that the Government enlarges the Welland Canal and proposes to canalize the French River to North Bay only:

The estimate for the enlargement of the Welland is generally stated to be $50,000,000.00; which amount at 4 per cent. interest, together with amortization, upkeep and supervision of the two existing canals and the proposed canal, may be estimated at another $1,000,000.00, or a total of $3,000,000.00 per year, which sum is probably under the mark unless all past experience in cost of Government contracts be reversed.

Assuming the distance from Port McNicoll to Montreal to be 400 miles, and a paying freight rate to be four-tenths cents per ton mile, or $1.60 per ton, or 5c a bushel, then $3,000,000.00 per year would pay the rail freight from Georgian Bay to Montreal on 60,000,000 bushels, which is much greater than the amount of grain and flour shipped in the past from Montreal in any one year, and 50 per cent. greater than the greatest Canadian tonnage through the Welland Canal bound down in one year.

Water Rights

This enlargement of the Welland Canal will not materially increase the water power development, as that is regulated by international treaty and works out so that, though Canada owns two-thirds of the water flowing over Niagara Falls, she gets the use of only one-third of the power development therefrom, the United States getting two-thirds.

It is manifest that the only saving effected by enlarging the Welland will be that effected by the difference in freight rates between 2,000-ton ships from Port Colborne to Montreal vs. 8,000-ton ships from Port Colborne to Prescott, plus 2,000-ton ships from

Prescott to Montreal, estimated above at ⅜c per bushel on wheat.

Oswego is about 150 miles nearer (by Erie Canal) to Troy than is Buffalo, and, as the enlarged Welland Canal will be, by treaty, free to United States ships, their largest lake ships will deliver grain cargoes to 1,500-ton United States barges at Oswego, in the New York State Barge Canal for New York instead of into 200 or 300-ton barges at Buffalo as at present, and thus compete with large Canadian ships discharging into 2,000-ton barges at Prescott or Kingston for Montreal.

In the past the little Erie canal boats taking grain from Buffalo to New York have been very keen competitors against the St. Lawrence route. What will be the result of the new conditions when in operation? It would appear that the expenditure on the proposed Welland Canal enlargement when completed will be quite as much to the advantage of the United States as to Canada, and during construction probably much more than half the cost goes to the United States for coal and machinery.

Canalization of French River

The canalization of the French River to North Bay to a depth of 22 feet, a distance of 82½ miles, is estimated to cost $14,275,000.00, and would develop 35,000 h.p.

It could bring coal and coarse freight to North Bay for railway distribution, and return pulp-wood and probably ores from that district, and partially develop a lot of power for which there is probably no immediate market in sight, but the value of which will doubtless be very great in a few years if we judge from the phenomenal increase in the use and value of hydro-electric power during the past twenty years. Probably this construction is warranted only in anticipation of the completion of the entire canal to Montreal.

Assuming that the appropriations in the estimates for the Welland and French River works are preliminary to the extension of each system through to Montreal:

The Welland-St. Lawrence system (unless an entirely new route inland to the north of the St. Lawrence can be found) passes through international waters from Kingston to Cornwall, and probably nothing can be done toward enlarging this portion without international agreement, including a natural demand by the United States for a share of the power development (loosely estimated at 2,000,000 h.p. by some writers in the press.)

Would the United States, having the free use of the enlarged Welland to carry their big ships to Oswego (the end of their Erie canal) consent to the enlarging of the St. Lawrence system to divert the trade from Troy and New York to Montreal? What share of the expense would they bear? What share of the power developed would they demand?

Sufficient information is not available to indicate the nature or cost of such an enlargement of the St. Lawrence canals, to a depth of 22 feet.

Ottawa-French River System

In the case of the Ottawa-French River system, careful surveys and estimates have been made by the Public Works Department. The total length of the canal is 440 miles, of which 346 miles is free navigation, 66 miles in improved channels and 28 miles in excavated canal. The cost is estimated at $100,000,000.

The system is estimated to be capable of developing one million h.p. on the direct route and 3,000,000 h.p. including the tributaries which probably within twenty years will (if carefully conserved and utilized by the nation) be worth from twenty to one hundred dollars per year per horse power utilized over the cost of production from coal, depending upon the purpose for which it is used.

In the absence of authentic estimates and reports on the St. Lawrence route, it is impossible to compare the two routes as to practicability, cost, time of transit and economy of operation. It is not known whether the St. Lawrence enlargement is at all possible due to international questions. If it be possible, then the two systems can be compared in regard to length and total height of locking only.

From Lake Superior to Montreal the Ottawa route is 661 miles long, and the total lockage up and down is 780 feet.

The Welland-St. Lawrence route is 943 miles long, and the total lockage is 578 feet.

Both routes pass through United States waters in the St. Mary River. The St. Lawrence route passes through contracted international waters at St. Clair River, Detroit River and St. Lawrence River.

The deepened Welland-St. Lawrence Canal would be found to have probably three times the length of actual excavated canal and about the same length of restricted river navigation, as compared with the Ottawa route.

Much has been written about fogs, rock-excavated channels and sharp curves on the Ottawa route. Any Canadian knows that the St. Lawrence probably suffers quite as much as the Ottawa from fogs. About half of the existing Welland Canal is in rock excavation and the new canal will not have less. It is not known how much of such channels the proposed St. Lawrence enlargement will include. The Ottawa route has sharp curves, so has the Thames below London, and it is not known what curves will be required on the proposed St. Lawrence enlargement. There are, however, sharp curves in swift currents in St. Mary River at Neebish and other points.

Without surveys the distances through restricted waters cannot be compared and therefore neither the time necessary to pass through, nor the dangers of navigation.

The St. Lawrence route is known to be longer and will demand greater fuel consumption per ton of freight, and probably more time in transit.

The weeks per year when they will be open for navigation will probably not greatly differ, although the St. Lawrence system would doubtless have a slight advantage in this respect.

If, as shown above, the annual expense of enlarging the Welland Canal alone would pay the freight on double the quantity of wheat and flour at present carried per year from Lake Huron to Montreal, it is unnecessary to prove that (commercially speaking) neither scheme can be defended as a canal solely. Without further information they cannot be compared physically, nor is the possibility of the St. Lawrence enlargement even sure.

Conclusion

Pending the result of discussion the writer cannot avoid the following conclusions:—

(a) Neither canal system can be made, as a canal, a commercial success;

(b) On account of the geographical position and abundance of power capable of being developed along the Ottawa-French River system, that canal and power development (if undertaken by the Government) can probably be made a commercial success in a few years and will be a very valuable asset in case of international disputes, giving Canada a chance for defence on the Upper Lakes that she can never enjoy without it. This canal might be considered by the Dominion Government on the same basis as colonization railways which have been freely encouraged all over Canada.

(c) The possibility of the enlargement of the St. Lawrence system is as yet undetermined, as it requires the co-operation of the United States;

(d) The cost and value of the power development thereon is unknown as no international agreement, surveys or estimates have been prepared;

(e) The enlargement of the Welland Canal without a corresponding enlargement of the Welland-St. Lawrence system will at least benefit United States quite as much as Canadian interests, and it is questionable if it will not divert trade from Montreal to New York.

(f) It will give the United States control of Lake Ontario in case of international trouble, and be an important factor contributing to the probable loss of the wealthiest and most populous part of Canada.

The Dominion Government has recently appointed a Commission to report on the proposed Ottawa Ship Canal, which doubtless will add much to the present knowledge of the commercial feasibility of this project, and it is to be hoped of an alternative project of a 14 ft. barge canal.

It is to be hoped that it will also give some similar information regarding the enlargement of the Welland Canal and the proposed extension of the enlargement to Montreal that will guide the Government in deciding on the wisdom of such vast expenditures of public money before the projects are actually undertaken.

It is to be regretted that a similar Commission had not been appointed before the Government committed the country to the expenditure of several hundred millions, on the simultaneous construction of two additional transcontinental railways, and numerous other expensive projects.

The Chemistry of Portland Cement

A research to determine the Chemical Constitution and Best Method of Production of this All-important Building Material

(Concluded from Feb 23)

By G. A Rankin

Three Types of Cement

The similarity of these three types of cement clinkers is not surprising if we consider their chemical compositions. The content of lime, alumina, silica of each type is over 90 per cent., while the composition relative only to these three oxides approaches a constant, the maximum difference being 2.5 per cent. in the case of alumina, since there is 6.5 per cent. in white cement and 9.0 per cent. in gray cement. We should expect, therefore, and it has been found experimentally to be true, that these three types of cement clinker are made up largely of the same constituents; these are, as we have shown, tricalcic silicate, dicalcium silicate, and tricalcic aluminate, all compounds of the three major components of cement.

Having shown that the components of Portland cement are CaO, Al_2O_3, SiO_2 in certain rather definite proportions and that the constituent substances are definite compounds of these oxides, let us consider the percentage of these compounds in the clinker. For example, let us take the average gray cement whose chemical composition has been given in Table I. If the clinker for this cement has been perfectly burned, it will consist of about 36 per cent. $3CaO.SiO_2$. 33 per cent. $2CaO.SiO_2$, 21 per cent. $3CaO.Al_2O_3$, and 10 per cent. of the minor constituents.

In the actual manufacture of Portland cement, however, the clinker is not always perfectly burned, that is, the raw materials are not always ground fine enough or heated to a sufficiently high temperature so that the chemical reactions are completed. The proportions of the constituents in commercial cement will then be somewhat different from those given. With our present knowledge of the nature of the chemical reactions, however, it is possible to state which of the constituents will not be completely formed. It will be remembered that, in the discussion of these chemical reactions, it was shown that $3CaO.SiO_2$ is the last constituent to form completely and this compound is formed by combination of CaO with the compound $2CaO.SiO_2$. It is evident, therefore, that when commercial clinker is not perfectly burned, there is less $3CaO.SiO_2$ and more $2CaO.SiO_2$ and CaO will be present as an individual constituent. In the example given there will be less than 36 per cent $3CaO.SiO_2$, more than 33 per cent. $2CaO.SiO_2$ and there will be a certain percentage of free CaO. The exact percentages will of course depend upon how near to completion the reaction, $CaO+2CaO.SiO_2=3CaO.SiO_2$ has been carried.

Complete Reaction

That the manufacture of good Portland Cement necessitates that this reaction be carried practically to completion is evident if we consider certain facts in regard to the influence of lime on the physical properties of Portland cement. Practical experience has shown that cements containing much free lime are unsound and that concrete made from them will in time disintegrate. This is due to the expansion of free or uncombined lime, when it reacts with water to form calcium hydrate. If, however, the lime in cements is all combined, they are sound and of good strength. The importance of the reaction $CaO+2CaO.SiO_2=3CaO.SiO_2$ is, therefore, apparent, since this reaction must go practically to completion in order that a sound cement may be produced. It has long been recognized that anything which will promote the combination of lime during burning will promote soundness in cement and that the greater the percentage of combined lime the greater the strength of the cement.

The average lime content of cement today is about 62.5 per cent., which is largely combined as $3CaO.SiO_2$,

$2CaO.SiO_2$ and $3CaO.Al_2O_3$. If the percentage of CaO were increased, it would tend to combine with the $2CaO.SiO_2$ to form more $3CaO.SiO_2$ and would so combine if the time of burning were long enough and the temperature sufficiently high. Since practical experience has shown that increased percentage of lime increases both the percentage of $3CaO.SiO_2$ and the strength of cements, it may be inferred that the strength of cements is largely due to the compound $3CaO.SiO_2$. If this is true, it is desirable that Portland cement should contain as high a percentage of this compound as is possible. An average Portland cement contains about 30 to 35 per cent. of this constituent. That Portland cement contains such a small amount of $3CaO.SiO_2$ is due partly to the fact that this constituent is formed with great difficulty and also to the fact that about 40 per cent. is the maximum yield which could be obtained from raw materials having the same CaO, Al_2O_3, SiO_2 composition as are now used.

Before taking up, however, a discussion of the probable value of $3CaO.SiO_2$ as a cementing material and the possibility of increasing its percentage in Portland cement, let us consider what is known as to the cementing value of the constituents of Portland cement, taking up first the changes which take place when Portland cement is mixed with water and hardens.

Chemical Action With Water

When Portland cement is finely pulverized and mixed with water, a hard mass is formed by chemical action between the water and the constituents of the cement. While there is still much to be learned as to the chemistry of the hardening of Portland cement, sufficient data on the hydration of the individual major constituents have been obtained to enable us to account for the gradual hardening and increase in strength and to indicate the relative value of these constituents as cementing materials.

Let us now consider the hydration of the three major constituents $3CaO.Al_2O_3$, $3CaO.SiO_2$, $2CaO.SiO_2$ in the order named. When pure $3CaO.Al_2O_3$ is mixed with water, an amorphous hydrated material is first formed. This material sets and hardens very rapidly. The compound $3CaO.SiO_2$ when mixed with water, also sets and hardens rather rapidly. In the case of this compound, as in the case of $3CaO.Al_2O_3$, the setting and hardening is due to the formation of an amorphous hydrated material on the individual grains which are thus cemented together. The extent of the hydration or the percentage of amorphous material which each grain will yield depends upon the percentage of water used and the time. With a given percentage of water the amount of amorphous material formed from the amount of the compound $3CaO.Al_2O_3$ in a given time is much greater than for the compound $3CaO.SiO_2$, that is, the compound $3CaO.Al_2O_3$ reacts with water much more rapidly than the $3CaO.SiO_2$. The compound $2CaO.SiO_2$ reacts very slowly with water and it is only after a long period of time that sufficient amorphous hydrated material is formed to cement together the grains of this compound and so form a hard mass.

The amorphous hydrated material formed by the action of water on the constituents of cement, does in time, no doubt, crystallize to some extent. From the data available it would appear that the crystals formed are calcium hydrate and some crystalline hydrate derived from $3CaO.Al_2O_3$. Apparently no crystalline hydrate of the calcium silicates is formed.

From this brief description of the action of water on the constituents of Portland cement, it will be seen that the setting and hardening of Portland cement involves the formation of an amorphous hydrated material which subsequently partially crystallizes; that the initial set is probably due to the hydration of $3CaO.Al_2O_3$; that the hardness and cohesive strength at first are due to the cementing action of the amorphous material produced by the hydration of this aluminate and of the $3CaO.SiO_2$; and that the gradual increase in strength is due to further hydration of these two compounds together with the hydration of the $2CaO.SiO_2$.

Of the three compounds which thus take part in the setting and hardening of Portland cement, the $3CaO.SiO_2$ appears the best cementing constituent; that is, this compound is the only one of the three which when mixed with water will set and harden within a reasonable time to form a mass which in hardness and strength is comparable to Portland cement. The compound $2CaO.SiO_2$ requires too long a time to set and harden, in order to be in itself a valuable cementing material. The compound $3CaO.Al_2O_3$, while it sets and hardens rapidly, is rather soluble in water and is not particularly durable or strong.

From this, again, it follows that the compound tricalcium silicate is the essential constituent of Portland cement, consequently the higher its percentage the better the cement. Granting for the time being that this is true, let us consider the nature of an investigation which might lead to the production of a cement containing a much higher percentage of $3CaO.SiO_2$ than is contained in Portland cement as made today.

Effect of Lime

In the discussion of the constitution of Portland cement we have shown that an average Portland cement contains about 30 to 35 per cent. tricalcium silicate, a proportion which closely approaches the maximum yield if the components are in the proportions of an average Portland cement. It has also been shown that an increase in the lime content of an average cement will increase the percentage of $3CaO.SiO_2$ if the conditions of burning are such that the reaction $CaO+2CaO.SiO_2=3CaO.SiO_2$ goes to completion. This, however, necessitates finer grinding of the raw materials, as well as burning for a longer time and at an increased temperature, factors which materially affect the cost of production. Now the data discussed above were obtained by applying the results obtained by an investigation of the equilibrium relations found to exist in the system CaO-Al_2O_3-SiO_2, to the actual manufacture of Portland cement; but this by no means implies that in presence of other components the conditions required for the production of an adequate amount of flux should not be more favorable and economical. In other words, the study of other systems may establish the economic possibility of producing a cement containing a high percentage of tricalcium silicate. For example, if some substance were substituted for the component Al_2O_3, in the system CaO-Al_2O_3-SiO_2, the study of the equilibrium relations found to exist in this new system would enable one to determine whether or not it would be economically possible to produce a cement containing a high percentage of $3CaO.SiO_2$ from raw materials of which the components are CaO, SiO_2, and this third substance. Thus if Fe_2O_3 were substituted for Al_2O_3, we could from the study of the system CaO-Fe_2O_3-SiO_2 ascertain the fineness of the raw material, and the time and temperature of burning, necessary to secure a clinker containing the highest percentage of $3CaO.SiO_2$ which could be economically produced from raw materials of which the major components are CaO, Fe_2O_3, SiO_2. This would require that one determine the nature of all compounds formed in mixtures of these three oxides which, when burned, contain $3CaO.SiO_2$, and that we establish the identity, melting temperature, and rate of formation, of $3CaO.SiO_2$ in such mixtures. Instead of substituting a single substance, it would undoubtedly be more desirable to substitute a number of different substances, since the presence of several produces a lower melting flux and thus makes possible the formation of $3CaO.SiO_2$ at a lower temperature. By proceeding in this way to determine systematically the various mixtures of substances, which, when burned, give high percentages of $3CaO.SiO_2$, it would not seem at all improbable that we may discover some mixture which could be economically manufactured and which would result in the production of a cement far superior to the Portland cement now made.

Essential Constituent

In this discussion we have assumed that tricalcium silicate is the essential constituent of Portland cement. If subsequent investigation should show that other constituents possessed superior cementing qualities, the nature of an investigation to determine the mixture which would economically produce the highest percentage of such a constituent, would be of the same general nature as that described for tricalcium silicate. Indeed, the determination of the constituents (compounds) which possess the best cementing qualities for various purposes may be determined in just this way, since the systematic study of the components found in cements enables one to isolate the separate compounds formed and to determine their cementing qualities pure and in mixtures.

In conclusion, let us recapitulate the main points contained in this paper. The value of Portland cement depends upon the fact that when finely powdered and mixed with water it forms a hard mass; and the strength and permanence of this mass depend upon the constituents of the cement. The major constituents are tricalcium silicate, dicalcium silicate and tricalcium aluminate. Of these constituents, the compound tricalcium silicate is the one which hardens and develops the greatest strength within a reasonable time. This most important constituent, which is the one formed with the greatest difficulty, makes up only about 30 to 35 per cent. of an average normal Portland cement. It may be said, therefore, that the essential process for the manufacture of Portland cement is the formation of this compound, and that any improvement in this process yielding an increased percentage of tricalcium silicate will increase the cementing value of Portland cement. In order to determine the most economical process for producing tricalcium silicate in the highest percentages, it will be necessary to study the rate of formation of this compound in series of mixtures of various substances; this, in turn, necessitates the determination of the equilibrium relations of tricalcium silicate at high temperatures in such mixtures. Such a procedure will lead sooner to the discovery of the optimum composition in various cases and for various purposes than the empirical cut-and-try methods which hitherto have been the only method tried.

Prof. E. Brydon-Jack read a paper entitled "Movable Bridges" on February 3 before the Manitoba Branch of the Canadian Society of Civil Engineers.

Protection of Concrete During Hot Weather

It is not at all uncommon to hear prominent engineers say that concrete placed during periods of extreme hot weather is in general weaker than that placed in winter, says the Contractor, if the materials are heated and the surface protected after placing. If it could be forcibly impressed on the minds of inspectors and contractors that protection of concrete surfaces from the direct rays of the sun during hot days is just as important as protection against cold in winter, this probably would not be true. There seems to be an erroneous idea prevalent among construction men that concrete should harden as rapidly as possible. They believe that concrete dries out in hardening similar to the action of lime mortar and therefore they provide no protection while the concrete is hardening. This state of affairs is no doubt due to the passing of many masons and helpers from their original field into the concrete field. Some of these so-called practical men will not be converted from this erroneous view and a vigorous campaign should be started against such ideas.

The very name "hydraulic" as applied to cements conveys the idea that water is required in the process of hardening. Exposed surfaces of fresh concrete should be protected from the direct hot rays of the sun by boards, building paper, or tarpaulins until final set has taken place; after this it is important that the concrete be kept moist for a period of a week or more after placing. If not kept moist and protected, there is danger of the water which is required for the process of setting and hardening becoming evaporated and the concrete "dried out" before the cement has set. Concrete that has prematurely set or dried out is never as strong as if kept moist while setting, and many times ultimate failure is laid to poor cement or aggregate when in reality the cause was lack of water while hardening.

The statement that the strength of concrete increases with age does not hold good if sufficient water is not supplied throughout the first stages of the hardening process. If the moisture is withdrawn from the concrete the increase in strength is arrested; and even if water is applied later it will do no good toward increasing the strength.

When concrete is unprotected and hardens rapidly, the tendency toward contraction is greatly aggravated and the outer surface is very likely to become "crazed" or covered with "hair cracks" and rendered otherwise unsightly. If concrete dries rapidly the color will be much lighter than if kept damp and allowed to harden slowly.

After an exposed concrete surface has received its final set, it should be covered with burlap (not cement sacks, they are too valuable) or wet sand spread over the surface to a depth of about one inch and kept wet by sprinkling. Where surfaces are not exposed but the concrete section is thin, the forms are likely to be very light, and if exposed to the sun will dry out quickly and absorb moisture from the concrete next to the forms. For this reason it is important to see that such forms are thoroughly soaked daily for a period of a week or more. Impress upon the contractor, inspector and workman that water is an essential element in the proper curing of concrete and better concrete will result.

Aggregates for Concrete Roads

Important advances made in the knowledge of concrete aggregate which compose 80% of material in a concrete road—Life of concrete roads depends on the durability, grading, cleanness and chemical composition of the aggregates

(Concluded from March 1st)

By D. A. Abrams

Experience in the selection of materials for concrete roads has indicated the importance of strength tests, particularly of fine aggregates. For strength tests of fine aggregates a 1:3 mortar mix has become standard, largely for the reason that differences in the mortar-making quality of the aggregate are emphasized by a comparatively lean mix. The standard tension briquet has been generally used for such tests. Recent experiences in the testing of aggregates have suggested that the briquet test of mortars may be of questionable value as a criterion of the concrete-making quality of any material. This has led to inquiry as to whether compression tests of sand mortars or concretes in which the aggregates in question are used may not be a safer guide.

It should always be recognized that mortar strength tests of fine aggregates are purely comparative. The actual values obtained in the test will depend largely on factors which cannot be covered by specification requirements, such as the properties of the cement used and minor differences in manipulation. Comparison of mortar strength with that of standard sand mortars seems to give satisfactory results.

In the "Proposed Specification for Concrete Aggregates," which accompanies this report, no mention is made of the form of specimen to be used. The proposed test for fine aggregate gives a direct comparison with standard sand mortar. The only requirements are that a 1:3 mix shall be used, that the plasticity of the mortar be similar, that the parallel sets of specimens be made by the same operator using the same cement, and that they be made, stored, and tested in the same manner. This leaves the form of specimen optional. It is suggested that compression tests be made on 2 by 4-inch or 3 by 6-inch mortar cylinders until a standard procedure for compression tests is agreed upon.

There is great need for a standard compression test for concrete which will enable comparisons of coarse aggregates to be made. Studies have already been directed toward the selection of a graded gravel or a crushed stone which may be used as a "standard coarse aggregate." Such a material would then bear the same relation to strength tests of concrete made of different coarse aggregates that standard Ottawa sand now bears to tests of mortars from fine aggregate.

Aggregate Materials

Information furnished by the Association of American Portland Cement Manufacturers indicates that the coarse aggregates used in concrete roads built in the United States to date may be classified as follows: crushed rock, all kinds, 55 per cent.; gravel, 40 per cent.; miscellaneous materials, 5 per cent. Natural sands account for nearly all the fine aggregate.

Granites and trap rocks, quartzite, conglomerates, hard limestones, sound, clean sands and gravels, close-grained sandstones and dense blast furnace slag of proper chemical composition are excellent aggregates for concrete roads; soft limestones, inferior sands and gravels, and other questionable materials should not be used in concrete roads.

It has not been considered feasible to present data on the distribution methods of production and cost of concrete aggregates.

Aggregate Specifications

Specifications for aggregates for concrete road building should be based upon definite requirements which are defined by tests of such an exact nature that only high-grade materials will be admitted. The ideal specification would define certain qualities by which all materials could be measured. This would probably imply carrying out a wear test of the finished concrete. Our present knowledge of the effect of variations in the materials used and the methods employed in making and handling concrete do not enable us to do this. The tendency has recently been in the opposite direction; namely, to fix different specification requirements for each class and size of aggregate material.

In the absence of information upon which to base a general specification, certain requirements for grading, cleanness, and mortar strength are found serviceable. The proposed specification for aggregates presented is based on the requirements of fine and coarse aggregates for one-course concrete road construction. A change in the maximum size of the coarse aggregate will be necessary to adapt the specification to the requirements for the top course of a two-course road. In the base of a two-course road, materials of a somewhat lower quality may be used, if it is economical to do so.

Some phases of the specification requirements for aggregate were discussed under "Aggregate Tests." The fine aggregate specification is directed with particular reference to natural sands.* The form of specimen to be used is left optional for the reason that both tension and compression tests are in use. The present trend of practice seems to be in favor of a compression test. The sliding scale of ratios between the strength of concrete sand and standard Ottawa sand mortars is based on the desirability of placing a premium on the results of the older tests.

Proposed Specifications for Aggregates for One-Course Concrete Roads

Aggregates: All aggregates used shall conform to the requirements of these specifications. Before delivery of material at the site of the work the contractor shall submit to the engineer a sample weighing not less than fifty (50) pounds of each of the fine and coarse aggregates proposed for use. The engineer shall determine, by means of tests, whether said samples comply with the requirements of these specifications. The acceptance of samples shall not be con-

* Mr. Mattimore votes "no" on the inclusion of screenings under the specifications for fine aggregates; and "no" on the value of 1 10 for the ratio of the ratio of the strength of fine aggregate mortars to standard Ottawa sand mortar at the age of 7 days.

strued as a guarantee of acceptance of other lots of material from the same source. The engineer may make tests on all lots of aggregate delivered on the work in order to determine whether specification requirements are met.

Fine Aggregate: Fine aggregate shall consist of natural sand or screenings from hard, tough, durable rock or gravel consisting of quartzite grains or other equally hard material graded from coarse to fine with the coarse particles predominating.

Fine aggregate, when dry, shall pass a sieve having four (4) meshes per linear inch; not more than ninety (90) nor less than fifty (50) per cent. shall be finer than a sieve having eight (8) meshes per linear inch. Not more than twenty (20) per cent. shall be finer than a sieve having fifty† (50) meshes per linear inch, and not more than five (5) per cent. shall be finer than a sieve having one hundred (100) meshes per linear inch. The above-mentioned percentages shall be computed on the basis of weight. Fine aggregate shall contain no vegetable or other deleterious materials, and not more than three (3) per cent. of the clay or loam, by weight.

Fine aggregates which give a mortar strength equal to or higher than the minimum value at any of the ages named below, shall be considered as fulfilling the mortar strength requirements of this specification.

Age at Test	Minimum Strength of 1:3 Fine Aggregate Mortar
72 hours	1.25 times (A)
7 days	1.10 times (A)
28 days	1.00 times (A)

(A) equals the strength of 1:3 standard Ottawa sand mortar specimens of same form and size, of similar plasticity, made by the same operator using the same cement.

The tests shall be made on mortars composed of one (1) part Portland cement and three (3) parts, by weight, of fine aggregate or standard Ottawa sand. The test specimens shall be made, stored, and tested in the same manner. All mortar strength tests shall be made under laboratory conditions in accordance with recognized standards. Each value shall be the average from tests of not fewer than three (3) specimens.

Coarse Aggregate: Coarse aggregate shall consist of clean, hard, tough, and durable crushed rock or gravel. Coarse aggregate shall contain no vegetable or other deleterious matter, and shall be free from soft, flat, or elongated particles.

Coarse aggregate shall be graded from two (2) inches down. The coarsest particles shall pass a two (2)-inch round opening. Not more than five (5) per cent., by weight, shall be finer than a sieve having four (4) meshes per linear inch.

Ready-Mixed Aggregates: Run-of-crusher stone, run-of-bank gravel, or other ready-prepared mixes of fine and coarse aggregates, shall not be used.

Field Inspection of Concrete Aggregates

Field inspection of concrete aggregates is understood to include visual inspection and all determinations which can be made by means of the physical senses and such apparatus as may be found ready at hand or conveniently carried about. It is recognized that the value of field inspection depends entirely upon the experience and training of the individual making such inspection. It is usually assumed that field tests are of such a simple character and of such an approximate nature that they can be carried out and properly interpreted by men of little or no experience in the use and testing of such materials.

The field tests which may be applied to advantage depend upon the nature, location, and previous treatment of the material. A careful examination of the surroundings from which a material comes and an inspection of the operation of the plant producing it frequently furnish valuable guides.

Field tests are frequently relied upon to give information as to the probable durability of a material, its cleanness, and grading. A sand which consists largely of soft particles, or is too fine, or contains a large percentage of impurities may properly be rejected on the basis of field inspection.

The grading of aggregates with reference to the amounts passing certain sieves can be determined roughly by means of a set of portable sieves. In the case of coarse aggregates a visual inspection will reveal the presence of large amounts of clay, loam, or soft pebbles in a shipment of gravel, and will indicate whether the material deviates largely from the proper grading.

A fairly exact determination of cleanness of sand may be made in the field by filling a cylindrical glass jar or bottle about half full of sand and adding sufficient water to cover the sand to a depth of 2 or 3 inches. Close the top of the vessel and shake vigorously for a few seconds; then set aside and allow the suspended material to settle on top of the sand. The length of time required for the water to become clear and the depth of the deposit on the surface of the sand give a measure of the foreign material present. If a graduated glass cylinder is used for this purpose a more accurate determination of the silt content of a sand can be obtained. This method sometimes fails in the tests of sands, which, on account of the color or grading, do not show a line of separation between the silt and sand. It should be noted that the results of this test cannot be compared directly with those obtained by the usual laboratory methods made on the basis of the loss of weight. In the field test mentioned above, the silt is determined on the basis of volume; the results are also influenced by the fineness of the silt and effect of the buoyancy of the water. This test will show a silt content varying from 60 to 200 per cent. of that found by the laboratory method in which running water is used and in which the loss is determined on the basis of weight.

Certain engineering organizations have provided their field inspectors with outfits consisting of two or three sieves, a glass graduate, rule, etc., which in the hands of intelligent men may be expected to give fair indications of the literature on the use and testing of concrete aggregates:

While the evidence of field inspection and tests should never be overlooked, it is generally recognized by progressive engineers that such tests are not sufficient for the purpose of discriminating between several lots of available materials, all of which may be of a good grade. Field tests may enable the engineer to determine whether a material complies with certain minimum requirements of a specification, but they give no reliable indication of the relative merits of different materials, and may prove wholly misleading. Field tests such as those described above reveal the presence of impurities, but they give no indication of their effect on the setting and hardening of the cement and on the

† The No. 48 sieve has openings of the same size as the usual No. 50 sieves.

final strength of the concrete. These remarks apply with particular force to natural sands.

A few engineers have carried field tests to the extent of making up blocks of mortar or concrete. By noting whether the concrete hardened satisfactorily, and by breaking with a hammer after a few days, or by loading to failure as a beam, they are assured that no serious mistake is being made. This, however, is a recognition of the value of tests of concrete aggregates, and amounts to conducting makeshift laboratory tests in the field.

Differences in the grading, hardness, silt content, etc., of sands, exert such an important influence on the strength, durability, and watertightness of concrete that the selection of suitable aggregates cannot properly be left to makeshift methods. Most engineers are now agreed as to the importance of properly-made laboratory tests for determining the relative value of aggregates for use in concrete roads.

Mainly Constructional

East and West—From Coast to Coast

The Alabastine Hardmortar, Ltd., have been succeeded by the Toronto Builders' Supply Co. Ltd.

The Toronto Plaster Company, Ltd., has been succeeded by the Toronto Builders' Supply Co., Ltd.

The Montreal Quarry Construction Supply Company, Ltd., Montreal, Que., have been granted a charter.

Plumbers' Exact Supplies, Limited, is the name of a new concern at Fredericton, N. B., with a capital stock of $20,000.

The value of the building permits issued in Welland, Ont., up to the end of February was $4,993, as against $3,270 for the corresponding period of 1915.

Vancouver building permits for the week ending February 26 numbered thirteen, and totalled $14,724 in value. This indicates greater building activity than for many weeks past.

Mr. Thomas I. Jackson, a well-known contractor of Ottawa, has enlisted, and will go to the front with the 156th Battalion, now stationed at Brockville. Two of Mr. Jackson's sons have also joined the colors.

The Callander Foundry and Manufacturing Company, Limited, has been formed with a capital of $40,000 and head office at Guelph, Ont. The provisional directors are J. M. Ferguson, J. P. Walsh, and A. C. Rutherford, all of Toronto.

The New York State Assembly recently passed a bill appropriating $10,000,000 for highway work in upstate counties. The money will come out of the second $50,000,000 highway bond issue, which has been apportioned among all the counties of the State except the five counties in New York City.

The Standard Marble and Tile Company, Limited, has been incorporated with a capital stock of $150,000 and head office in Toronto. The incorporators are F. C. Dunham, G. R. Sproat, F. M. McDowell, C. H. Kemp, and R. Sheppard, all of Toronto.

The members of the Toronto Section of the Ontario Architects' Association have expressed their strong commendation of the action of Mr. W. W. Pearse, city architect of Toronto, in refusing to set aside the building restrictions by granting a permit for the enlargement of the Gem Picture Theatre. The city by-laws of Toronto say that all houses seating over 500 must be of fireproof, first-class construction. The city council apparently overlooked this bylaw and voted by 11 to 5 in favor of allowing alterations to be made to this theatre whereby the seating capacity would be increased from 471 to 771, without making the building of fireproof construction. The matter was quickly adjusted however when Mr. Pearse explained the situation.

The painters and paperhangers of Regina, who have been out on strike for over a week, have returned to work. The strike was holding up two large contracts—the Simpson Building and the Regina College. It is understood that the men have returned to work pending a satisfactory arrangement regarding the scale of wages at a later date.

There were 165 building permits applied for during the month of February in the city of Toronto. These involved an expenditure of $627,329. In the same month of 1915 the number of applications was 149, with a value of $364,821. The number of permits issued during the month was 156, representing an expenditure of $191,459, as against 136 and $199,600 in the same month of 1915.

Until the independent commission appointed to investigate the aqueduct on the Greater Winnipeg Water District line has fully inspected the cracks that have appeared, and reported on the best method of procedure, there will be no more work on the project, according to an announcement made by Mayor Waugh, of Winnipeg. It is hoped that this report will be ready by May 1. The commission was appointed on February 25.

At the annual convention of the Western Ontario Clay Workers, held in London, Ont., last month, D. Wigle, of Kingsville, and R. Wehlan, of Windsor, were appointed a committee to investigate conditions at border points, especially Windsor, where it is claimed Detroit brick manufacturers are shipping in huge quantities of bricks, and after paying duty, selling at a much lower price than Canadians The Government will be asked to increase the tariff.

The Mainland Engineering Company, Limited, Victoria, B. C., has been incorporated to take over the plant and goodwill of the Mainland Iron Works, in liquidation, from the purchaser, Mr. Charles R. Gordon. The consideration for the purpose is 32,000 shares in the new company, fully paid up, and the assumption by the company of $18,000 owing by Mr. Gordon on the purchase price of the plant. The new company does not take over any of the liabilities of the Mainland Iron Works.

With the prospect of an improvement in building conditions, and a consequent demand for cement, the Union Cement Company of Owen Sound, Ont., have a number of their employees busy overhauling the plant with the object of starting operations early next month. The contract for a hundred thousand barrels just closed with the city of Toronto, will supply something definite to work on for the start. The company have a large quantity of gravel on hand from Griffith's Island, and a contract has been let for the coal supply.

The longest made road in the world is just now nearing completion. It is 3,384 miles in length, and extends from New York to San Francisco. It is designed primarily for motor traffic, but other vehicles will not be debarred from using it. Its average width is about 60 feet, and it passes in a direct line through twelve States and more than 200 counties. It has been christened "Lincoln Highway," after President Lincoln. The famous "Exiles Road," which runs across Siberia from Nishni Novgorod to Ke-akh-ta, a distance of about 5,000 miles, is, of course, longer than the above, but it is not, strictly speaking, a "made road," having been beaten originally into a trail by the feet of the poor exiles in the pre-railroad days.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

I wonder what Premier Hearst and his friends think now of J. R. Fallis, and at the same time I would like to know whether Sir Robert Borden has seen the handwriting upon the wall. Fallis is the man who used to represent Peel county, Ontario, in the local legislature. The Davidson Commission showed him up in connection with profits he is said to have made in purchasing horses for the Government. Many a man has disappeared from public life for dealings of this kind, but Fallis did not see it this way; neither did Premier Hearst. Fallis simply resigned and sought vindication by the re-election route. Peel county electors took a different view of it, however, and turned Fallis' former majority of 627 into a Liberal majority of over 300; a turn over of about 1,000 votes. They have given the first public reply to profiteering methods.

Fallis' defeat is a lesson for Fallis, and a pretty clear announcement of the downfall of any others who follow his ideals. If Fallis had made his commission honestly on the horse deals he should have kept it. Handing it over for a patriotic purpose and then seeking re-election was too much for independent Conservatives to stomach. They simply felt that a member of the Government, in his own interest even, should keep his skirts clear, and they went out and voted against Fallis.

When will political leaders in Canada realize that honesty is the best policy and that clean Government would remain in power indefinitely? That is what I have been trying hard to hammer in, but the task grows more and more difficult, and the Government, instead of taking my good intentions at their face value, has been misconstruing them and classing me with its enemies. If Sir Robert Borden would rise above party politics he would realize that behind these criticisms there lies the best friend the Government could have—the independent citizen who would gladly see him measure up to the stature of a clean and a great political leader.

If Sir Robert Borden fails to see the Peel result in the light of a warning closely related to the Shell Committee situation, he ought at least to recognize it as a public assurance that the people will stand behind him if he tries to stamp out the profiteering business. The defeat of Fallis cannot be taken as a Conservative defeat or as a Liberal victory. It is an announcement of the public temper about profiteering and what it means to any party which fails to stamp it out.

Here is the opinion of a strong Conservative paper (The Montreal Star) on the events in Peel County:—

The electors of Peel County, Ont., are worthy of public congratulations and universal gratitude from the entire people of Canada.

* * *

When Colonel J. Wesley Allison gave evidence some time ago before the Davidson Commission he stated that he "was not the agent of any company which sold pistols to the Government" and did not profit "in any way, directly or indirectly," by such sale. Major General Sir Sam Hughes, however, now classes him as his special confidential agent in securing munition supplies in the United States, and in cutting down war combine prices charged there. The latest evidence about this special confidential agent was read before the commission a few days ago. Samuel M. Stone, vice-president of the Colt Patent Fire Arms Company of Hartford, Conn., tells of an order for 5,000 pistols given to the company, after a conference between the chairman of the company's board, Colonel Allison, and General Hughes at Moira, N. Y. He states that the Canadian Government paid $18.50 for each pistol, while the U. S. Government has for years been able to buy them for $14.50, and that dealers could buy them nearly 20 per cent. cheaper. Mr. Stone adds that the company gave Col. Allison a "present," a very small one indeed considering his services, but a "present" for all that, and that he "would not like to consider Colonel Allison one of our regular staff."

At present Colonel Allison is in Florida for his health. When he comes back we are told he will be called upon to give more information. Perhaps we will then get at the facts—learn how much he got for a "present" and just what he considered his duties to be, as Major-General Sir Sam Hughes' special confidential agent for keeping down war combine prices. Perhaps too, we shall be given an inside account of the conference at Moira between Colonel Allison, General Hughes and the chairman of the Solt Company's Board.

* * *

And, by the way, it is decidedly encouraging to note the evidences of independence being shown in our western provinces. In Manitoba and Saskatchewan the honest electors are beginning to make themselves heard. In British Columbia, two ministers in one week is a fine record against the "corrupt combination," as Sir Hibbert Tupper puts it. Sir Hibbert's active participation in this campaign is all the more significant when we recall that the name Tupper has stood for many years in Canada for staunch Conservatism and rugged honesty.

The handwriting on the wall is becoming crowded. Does Sir Robert Borden still persist in closing his eyes to it?

—SEARCHLIGHT.

Personal

Mr. Philip J. Turner, F.R.I.B.A., recently gave an interesting address on "Belgium; Its People and Its Architecture," before the St. James Literary Society, Montreal.

Mr. C. E. Fowler, C. E., the well-known engineer of Seattle, Wash., delivered an address on Bridge Architecture before the Victoria Branch of the Canadian Society of Civil Engineers on February 22. The address was illustrated by a fine series of photographic slides. Mr. Fowler made a plea for the utilization of art and symmetry in design.

Mr. D. H. McDougall has been appointed general manager of the Dominion Steel Corporation, of Montreal. Mr. McDougall is a Nova Scotian. He began his career at the bottom of the ladder in the service of the Dominion Iron and Steel and Dominion Coal Companies, being employed in various capacities in the mining, mechanical, and civil engineering departments. Subsequently he spent two years in the study of mining and steel works engineering in the United States, and was for a time employed in the engineering department of the New York Central Railway. He returned to Nova Scotia to accept the position of superintendent of the extensive iron ore mining operations of the steel company.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Assiniboia, Sask.
The Town Council are considering the construction of a waterworks system this summer. Clerk, J. R. Nolan.

Calgary, Alta.
The estimates for the year include $65,000 for an addition to the reservoir, $51,600 for re-arrangement of the reservoir mains and $54,560 for paving and grading. Engineer, G. W. Craig; Commissioner, F. Garden.

Elma Township, Ont.
Tenders on the construction of the Peet Drain will be received until March 11th by the Reeve, William Scott, Monkton, Ont.

Humboldt, Sask.
The Town Council will shortly call for tenders on the construction of a concrete reservoir. Estimated cost, $4,000. Clerk, W. H. Stiles.

London, Ont.
The City Council are about to lay 5,000 feet of watermains by day labor. Estimated cost, $11,500. General Manager, E. V. Buchanan.

The City Council will shortly take up the proposal to extend the breakwater at West London and to construct sidewalks on it. Engineer, H. A. Brazier.

New Waterford, N.S.
The Town Council propose to expend $25,000 on the construction of pavements, sidewalks and sewers during the year. Clerk, James L. McKinnon.

Ste. Anne de Sorel, Que.
Frank Cote has started work on the construction of a waterworks system for the Village.

St. Catharines, Ont.
The City Council propose to construct the following works during the season:—brick pavements, $7,500; concrete pavements, $15,500; bitulithic pavements, $19,000; relief sewer, $40,000; tile sewers, $8,000; concrete sidewalks, $8,000. Engineer, W. P. Near.

St. Martine, Que.
The Town Council propose to lay about two miles of macadam road this summer. Secretary, N. Mallette.

Toronto, Ont.
The following sums are included in the current estimates of the Works Department:—sewers, $147,500; storm sewers, $121,500; watermain extensions, $63,203; extensions to the high pressure system, $500,000.

CONTRACTS AWARDED

Lachute, Que.
The Town Council have awarded a contract to Robert McArthur, Lachute, for the construction of an 8 inch watermain through the west end of the Town. Approximate cost, $3,200.

Ottawa, Ont.
The City Council have awarded a contract for the supply of pipe for extensions to the watermains to the National Iron Works, Cherry Street, Toronto.

The City Council have let the following contracts for supplies:—special pipe castings, Thomas Lawson & Son, Wellington Street; lead pipe, McKinley & Northwood, Rideau Street, $15,000; 4-inch and 24-inch valves, McDougalls Ltd., Sussex Street, $2,965; 5-inch and 30-inch valves, General Supply Company, Sparks Street, $2,546; pipe, National Iron Works, Cherry Street, Toronto; brass work, General Supply Company, Sparks Street, $2,820.

Peterborough, Ont.
The City Council have let contracts for the supply of tile pipe to R. Hicks & Company, Murray Street, and H. B. Taylor & Son, 160 Aylmer Street.

Railroads, Bridges and Wharves

Alfred, Ont.
The Village Council propose to construct a bridge at an estimated cost of $12,000. Clerk, B. G. Parisien.

Blandford Township, Ont.
The erection of a bridge is being considered by the Township Council. Clerk, George Oliver, Bright.

Lambton County, Ont.
The County Council have passed a by-law providing for the construction of a bridge over Bear Creek at an approximate cost of $7,000. Clerk, John Dalziel, Sarnia, Ont.

Normanby Township, Ont.
The Township Council propose to construct two or three steel bridges this season. Clerk, R. H. Fortune, Ayton.

The Pas, Man.
The Dominion Government Department of Public Works are considering the expenditure of $30,000 on the docks. Secretary, R. C. Desrochers, Ottawa.

Toronto, Ont.
The Works Department have included the following sums in their estimates for the year:—Spadina Road bridge, $50,000; Glen Road bridge, $111,000; Summerhill Avenue bridge, over the C. P. R. tracks, City's share, $188,000.

CONTRACTS AWARDED

Biddulph Township, Ont.
The contract for the construction of a bridge over the Sauble River has been let by the County Council to D. Witherspoon, Craig Street, London. Estimated cost, $3,000.

Brantford Township, Ont.
The following contracts for the erection of the Fonger and Barton bridges have been let by the Township Council: concrete abutments of both bridges, George Thomson, Brantford, at $4,615; steel superstructure of Fonger bridge, Hamilton Bridge Works Company, Ltd., Bay Street N., Hamilton, at $2,425; steel superstructure of Barton bridge, Dominion Bridge Company, Ltd., Imperial Life Building, Toronto, $2,530.

Calgary, Alta.
The contract for the supply of steel required in the completion of the Centre Street Bridge has been awarded by the City Council to the Western Foundry & Supply Company, Ltd., Calgary, at $3.10 per 100 pounds.

Rimouski, Que.
The general contract for the construction of a wharf has been awarded by the Department of Public Works, Ottawa, to Raymond & Talbot, Rimouski.

St. Jerome, Que.
The Town Council have let the contract for repairs to the Vaillancourt bridge to A. P. Belair, St. Jerome. Work has been started. Steel and wood construction.

Wardsville, Ont.
The Middlesex County Council have let a contract for remodelling a bridge to the Petrolia Bridge Company, Petrolia, at $4,100.

Public Buildings, Churches and Schools

Arnprior, Ont.
Plans have been prepared for iron and reinforcing for the fire escapes at the Town Hall. Tenders will be called by the Mayor. Architect, J. P. MacLaren, 101 Sparks Street, Ottawa.

Basswood, Man.
Frank R. Evans, 170 Pacific Avenue, Winnipeg, is preparing plans of a school for the School Board. Four rooms. Estimated cost, $14,000.

Beamsville, Ont.
Work may start in the spring on the erection of a high school, estimated to cost $20,000. Plans have not yet been prepared. Secretary to the School Board, James Sinclair.

Breeshwood, Sask.
The erection of a frame school is being considered by the Trustees of School District No. 3668, Breeshwood. Secretary, Everett Simpson, St. Brieux, Sask.

Byron, Ont.
The London Health Association are considering the erection of an addition to the Sanitorium. Approximate cost, $10,000. President, Sir Adam Beck, 169 Albert Street, London.

Cameron, Man.
The School Board are considering the

erection of a school at an approximate cost of $5,000. Secretary, J. W. Halpenny, Minnedosa, Man.

Chinook, Alta.
The School Board contemplate the erection of a school to cost $5,000. Secretary, M. J. Hewitt.

Dominion City, Man.
The School Board propose to build a school at an approximate cost of $20,000. Architect, Frank R. Evans, 170 Pacific Avenue, Winnipeg.

Florence, Ont.
The Village Council contemplate the erection of a hall and have had plans prepared by James L. Wilson & Son, 80½ King Street W., Chatham. Estimated cost, $3,000.

Frobisher, Sask.
The erection of a school is being considered. Secretary to the School Board, C. S. Chappell. Estimated cost, $5,000.

Hilliard Township, Ont.
The Trustees of School Section No. 3 are considering the erection of a school. Secretary, Charles Pratt, Thornloe P.O.

Humber Bay, Ont.
Tenders are now being received for alterations and additions to a school for the Trustees of School Section No. 11, Etobicoke. Architect, J. A. Thatcher, 37 Cowan Avenue, Toronto. Approximate cost, $4,000.

Kenora, Ont.
Tenders will be called for the erection of a hall and store building for Harmony L.O.L. No. 1689. Secretary, H. C. King. Estimated cost, $5,000. Architect, F. A. Hudson.

The Ruthenian Roman Catholic Congregation propose to build a church. Secretary, W. Poranski.

Kingston, Ont.
E. R. Beckwith, Cooper Street, is preparing plans of a hall for the Orange Lodge. Pressed brick construction. Estimated cost, $11,000.

Montreal, Que.
Tenders will be received until March 15th for the erection of a school for the Cote des Neiges Roman Catholic School Board. Architect, George A. Nonette, Power Building, Craig Street. Brick construction, felt and gravel roofing.

Niagara Falls, Ont.
Plans are being prepared by C. M. Borter, Main Street, Niagara Falls South, for repairs to the Parish Hall of Christ Church which was damaged by fire.

North Sydney, C.B.
The School Board are considering the erection of a school, to cost about $10,000. Work many not start this year. Secretary, Neil McLean.

Nova Scotia Province
The School Boards of Central Onslow, Upper Onslow and Onslow Mountain are considering the erection of schools. Secretaries, D. McNutt, Central Onslow, Henry Hislop, Onslow Station, and C. W. McCully, Onslow Mountain.

Ottawa, Ont.
The Ottawa Collegiate Institute are having plans prepared for alterations to the Ladies College, Albert Street, which is to be used as a Collegiate. Architect, J. Albert Ewart, Booth Building, Sparks Street.

Saskatchewan Province
The erection of a school is contemplated by the Trustees of School District No. 3667, Cavell. Secretary, H. Wright, Sturgis P. O.

The Trustees of Malonick School District No. 3669 are considering the erection of a school. Secretary, J. D. Laittre, Malonick.

The Trustees of School District No. 126, Pachonan, propose to build a school. Secretary, J. Strachan, Glen Mary.

The erection of a school is proposed by the Trustees of Langmarch School District No. 3683. Secretary, L. R. Fawcett, Advance, Sask.

Smith's Falls, Ont.
The School Board contemplate the rebuilding of the school which was recently destroyed by fire. Estimated cost, $30,000. Secretary, C. T. McBride.

St. Alphonse de Thedford, Que.
The School Board will call for tenders very shortly for the erection of a frame school. Estimated cost, $3,000. Secretary, Achille Therrien.

Stratford, Ont.
James Russell, 21 Downie Street, is preparing plans for a school to be built on Downie Street for the Public School Board. Chairman, A. W. Fisher. Estimated cost, $25,000.

Thamesville, Ont.
The School Board propose to install fire escapes and a quantity of seating. Secretary, K. Kistruck.

West Lorne, Ont.
Plans for an addition to the school are being prepared by W. G. Murray, Dominion Savings Building, London. Tenders will be called soon. White brick construction. Approximate cost, $7,000.

Whitebread, Ont.
The School Trustees propose to build a school at an approximate cost of $1,000. Inspector, J. H. Smith, 47 Victoria Street, Chatham, is in possession of plans and other information.

CONTRACTS AWARDED

Glen Robertson, Ont.
In connection with the Roman Catholic Church now being built, the contract for steel has been let to P. J. Powert, Bridge Street, Ottawa, and the roofing to Ludowie Siladin Company, Chicago.

Hamilton, Ont.
The City Council have awarded the contract for painting at the City Hall and House of Refuge to F. W. Kirk, 205 Charlton Avenue W.

Joliette, Que.
The basement of the proposed church for the Roman Catholic congregation is now being constructed. The contract for piling and concrete work has been let to W. A. Wood, 315 Hutchison Street, Montreal.

London, Ont.
The Department of Militia have let the general contract for the construction of a Soldier's Hospital to S. Willis & Son, 765 Talbot Street, at $12,000. Architect, A. E. Nutter, Dominion Bank Building.

London Township, Ont.
The Trustees of School Section No. 23 have let the contract for the erection of an addition to the school to M. J. Morrison, Dundas Street E., London. Estimated cost, $3,000.

St. Anne de la Pocatiere, Que.
The general contract for the erection of a chapel at the College of St. Anne Pocatiere has been awarded to J. St. Hilaire, St. Ronald, Que.

St. Hyacinthe, Que.
The contract for alterations to the heating system at the Seminary of St. Hyacinthe has been awarded to Hector Lorange, 254 Cascades Street. Work will include the repairing of iron pipes by copper ones.

Toronto, Ont.
The following contracts have been awarded in connection with the chapel which is being built for the Monastry of Our Lady of Refuge:—slate roofing, Douglas Bros., 124 Adelaide Street W.; painting, A. Richards, 403 Spadina Avenue; plumbing, D. Glynn & Son, 156 Arthur Street. Heating, plastering and wiring not yet let.

Business Buildings and Indu - trial Plants

Burquitlam, B.C.
The Burquitlam Agricultural Society are to have plans prepared for enlargement of their buildings. Architect, F. Horrel.

Drummondville, Que.
Work is expected to start very shortly on the construction of a sulphuric acid plant for the Aetna Chemical Company of Canada, Ltd., Drummondville. Estimated cost, $300,000.

Guelph, Ont.
New plans are being prepared for a theatre to be erected on St. George Square for the Griffin Amusement Company, Ltd., 8 Queen Street E., Toronto. Estimated cost, $12,000. Architect, W. A. Mahoney, Telephone Building.

Halifax, N.S.
The City Council contemplate the erection of an abattoir at an approximate cost of $20,000. Clerk, L. F. Monaghan.

Ingersoll, Ont.
Work has been started on the remodelling of a building on King Street for M. J. Clear. Frame construction. Work by day labor.

Joliette, Que.
The Joliette Steel Company are building an addition to their plant, and will require machinery for steam and electrical power.

London, Ont.
John M. Mppre, 243½ Richmond St., is preparing plans for remodelling stores for J. C. Duffield, care of City Gas Company. Estimated cost, $7,000. Work will include store fronts, steam heating and interior decorating.

The London Foundry Company are considering the erection of an addition to their premises, to cost about $10,000. Manager, E. Grobb.

The Department of Miltia & Defence are preparing plans for a building to be erected at Carlings Heights, at an estimated cost of $4,000. Particulars from Major Bishop, Wolseley Barracks, London.

Montmorency Falls, Que.
The Dominion Textile Company, Limited, propose to erect a large mill.

Montreal, Que.
Joseph Gertler, 676 Drolet Street, has commenced repairs to his iron works on Bellechasse Street. Estimated cost, $3,500.

The Fairman Estate, care of F. W. Fairman, 232 St. James Street, will call for tenders on repairs to a business block on St. Catherine Street West as soon as plans and specifications are prepared.

Montrose, Ont.
The Michigan Central Railroad Company, Detroit, contemplate the erection of a round house, coal dock, etc., at an approximate cost of $250,000. Work may start very shortly.

Mt. Brydges, Ont.
The Crow Motor Car Company propose to build an addition to their factory, at an approximate cost of $10,000. Manager, John Stuart.

New Westminster, B.C.
The Canadian Northern Railway Company, Toronto, propose to build a railway station at an approximate cost of $50,000, and plans have been submitted to the City Council by the General Manager of the Western Division, M. H. MacLeod, Vancouver. Brick and stone construction.

Ottawa, Ont.
Plans for a store and residence to be built on Bank Street have been prepared by James & Frank Wilson, 8 Allan Place. Brick veneer construction, concrete foundation, felt and gravel roofing. Estimated cost, $6,000.

Port Elgin, Ont.
Tenders will be called immediately on the erection of a garage for John Coulter. Brick construction. Plans prepared by owner.

Sorel, Que.
A. Chapdelaine, Royale Street, contemplates rebuilding the stores and residences which were destroyed by fire last fall.

Spirit River, Alta.
Plans for an elevator will be prepared by F. Gillipse. Structure will be built this year.

Stratford, Ont.
Work is about to start on the erection of an addition to the premises of the George McLagan Furniture Manufacturing Company, Ltd., Trinity Street. Architect, James S. Russell, 21 Downie St.

Toronto, Ont.
W. C. Charters, 808 Kingston Road, proposes to build a block of stores on the Kingston Road, at an approximate cost of $25,000. Architect, P. H. Finney, 79 Adelaide Street E.

The Property Committee have granted permission to the Militia Department for the erection of a bunk house at Stanley Barracks. Frame construction. Colonel Coldwell, Exhibition Grounds, is in charge.

The Property Committee have approved plans for a fire hall in the Wychwood District, estimated to cost $24,000. Tenders will be called shortly. Brick and steel construction. Plans prepared by City Architect W. W. Pearse, City Hall.

Tenders are now being received for the erection of a store and apartments at St. Clair Avenue and Vaughan Road for Rowell & Company, 74 Vaughan Rd. Brick construction, felt and gravel roofing. Estimated cost, $7,000.

The United Cigar Stores, Ltd., 281 King Street West, contemplate alterations to a store at 167 Yonge Street.

J. A. Thatcher, Architect, 37 Cowan Avenue, is receiving tenders on the erection of a store and bakery on King St. near Portland Street. Brick construction, felt and gravel roofing. Approximate cost, $10,000.

Tenders on the erection of a private hotel at 559 Sherbourne Street will be received until March 14th by N. G. Beggs, Architect, Cosgrave Building. Brick construction. Estimated cost, $250,000.

In connection with the erection of a garage and showrooms at 249 Simcoe Street for the Automobile & Supply Company, a permit has been issued for an additional storey. Engineers, Harkness & Oxley, Confederation Life Building.

Prices on material required in the erection of a warehouse and factory on Princess Street for the Laura Secord Candy Company are being received by the Superintendent of Construction, H. T. Hickey, 69 Princess Street.

Victoria, B.C.
The Canadian Northern Railway Company, Toronto, are considering the erection of an office building at Fort and Government Streets. A two-storey building will be erected, but provision will be made for raising it to six storeys when desired. Purchasing Agent, E. Langhan, Winnipeg.

Whitebread, Ont.
Hugh Turner proposes to build a barn in the spring and will prepare plans.

CONTRACTS AWARDED

Georgetown, Ont.
In connection with the factory which has been built by the Glass Garden Builders, Limited, 201 Church Street, Toronto, the contract for wiring has been let to R. A. L. Gray & Company, 85 York Street, Toronto.

Lanigan, Sask.
The general contract for the erection of a creamery for the Lanigan Creamery Company, Limited, has been let to Miner Ball Company, 614 Ninth Street. Frame construction. Approximate cost, $5,500.

Montreal, Que.
In connection with the machine shop which is being erected for the Williams Manufacturing Company, Ltd., 1789 St. James Street, the contract for installation of a sprinkler system has been let to W. J. McGuire, 332 Craig Street W., and the plumbing, heating and painting to the general contractors.

The following contracts have been awarded for extensions to three stores on Laurier Avenue W., for G. A. Tiffin, care of John Hyde, 205 St. James Street: brick work, S. Rochon, 670 Outremont Avenue; roofing, heating and plumbing, J. J. Briard, 1277 St. Dominique Street; plastering, J. Chamberland, 553 Durocher Street; painting, T. Peladeau, 197a Champ de Mars; electrical work, Peerless Lighting Company, 319 St. Lawrence Street. Foundations and carpentry by the general contractors, J. B. Gratton, Ltd., 600 Labrecque Street.

The contract for electrical work required in connection with the machine shop which has been built for the Williams Manufacturing Company, Limited, 1789 St. James Street, has been awarded to Philip Lahee & Company, 2081 St. Nicholas Street.

Peterborough, Ont.
The contract for electrical work required in connection with the addition now being built to the premises of the Auburn Woollen Mills, River Road, has been let to F. R. McPherson Company, Limited, George Street.

Quebec, Que.
The contract for heating and plumbing required in connection with the theatre which has been erected on Labrecque Street for the Quebec Theatre Company has been awarded to Jobin & Paquet, 78 Cote d'Abraham.

Shawinigan Falls, Que.
Plans are being prepared for the construction of a paper mill for the Belgo-Canadian Pulp & Paper Company. The contract for concrete foundations has been awarded to the Raymond Concrete Pile Company, New Birks Building, Montreal.

St. John, N.B.
Work is about to start on alterations to the premises of the W. H. Thorne Company, Ltd., Market Square. The contract for masonry and carpentry has been let to R. A. Corbet, Douglas Avenue, and the painting to James Pullen, Horsefield Street.

Toronto, Ont.
The general contract for alterations to a store at Keele and Dundas Streets for the United Cigar Stores, Limited, 281 King Street West, has been let to D. Mann, 11 Hayter Street. Tenders for wiring are being received by the general contractor.

The following contracts have been let for the erection of a warehouse on Church Street for the Club Coffee Company, 27 Church Street:—masonry, Orr Bros., Ltd., 29 Queen Street E.; carpentry, T. J. Sproule, 54 Shanley Street; steel, Dominion Bridge Company, Victoria Street; roofing, Reggin & Spence, 530 Front Street W.; painting and glazing, J. McCausland & Son, 11 Nelson Street; plumbing and heating, R. Jordan, 37 Hazelton Avenue; wiring, Bennett & Wright Company, 72 Queen Street East.

Vancouver, B.C.
In connection with the premises in course of erection at Granville and Pender Streets for the Merchants Bank of Canada, Montreal, the contract for heating and plumbing has been let to Kydd Bros., 155 Pender Street W., the electrical work to Mundy, Rowland & Company, Standard Bank Building, and the painting to J. S. Abbs, 2125 13th Ave. W.

The general contract for the erection of a theatre for C. M. Bowman, Albert Street, Southampton, Ont., has been awarded to Adkinson & Dill, Wellington

Block. Some trades will be sub-let. Approximate cost, $40,000.

Welland, Ont.
The general contract for the erection of an addition to the plant of the Union Carbide Company has been awarded to J. C. Diffin. Reinforced concrete construction. Estimated cost, $20,000.

Residences

Chatham Township, Ont.
The erection of a residence is contemplated by J. Makiosi, Wallaceburg, Ont.

Chesley, Ont.
W. G. Murray, Dominion Savings Building, London, is preparing plans for a bungalow to be built for Wellington Krug, Chesley. White brick construction. Estimate cost, $4,500.

Dashwood, Ont.
William Held has had plans prepared for a residence, estimated to cost $3,000. White brick construction.

Easthope Township, Ont.
Charles Cook, Gravel Road, Stratford, is preparing plans for a residence, estimated to cost $3,500. Milton pressed brick construction.

Eastview, Ont.
Charles Aubrey, Main Street, is about to build a residence, estimated to cost $3,500. Frame construction.

Hagersville, Ont.
Charles Robins, R. R. No. 4, Hagersville, contemplates the erection of a residence.

Hamilton, Ont.
Plans have been prepared for a Nurses' Home in connection with the Mount Hamilton Hospital, and tenders will be called very shortly. Architect, W. P. Witton, Hamilton Provincial & Loan Building.

Ingersoll, Ont.
Plans are being prepared for a residence to be built on Thames Street for E. Wright, care of Wright Dry Goods Company. Red brick construction. Estimated cost, $3,500.

Knowlton, Que.
F. S. Mallory, 65 Adelaide Street E., Toronto, is preparing plans for a residence, estimated to cost $10,000. Tenders will be called later.

Levis, Que.
Plans of a residence are now being prepared for R. Roy by L. E. Auger, 39 St. Jean Street, Quebec. Estimated cost, $12,000.

Cherrier Bunville is having plans of a residence prepared by L. E. Auger, 39 St. Jean Street, Quebec. Estimated cost, $4,000.

London, Ont.
W. G. Murray, Dominion Savings Building, is preparing plans for remodelling a residence for W. Parr, 464 York Street. Work will start shortly. Estimated cost, $5,000.

R. H. Smith, 157 Wharncliffe Road, has commenced the erection of a residence, estimated to cost $3,000. White brick veneer construction.

A. Dickenson, 4 Ingleside Street, has commenced the erection of a residence on Duchess Avenue. Estimated cost, $3,000. White brick veneer construction.

Bert Weir, 493 Adelaide Street, is preparing plans for three residences to be built on Reyburn Street at an approximate cost of $6,000. White brick construction.

William Riley, Glebe and King Streets, is preparing plans for two residences, estimated to cost $3,800. White brick construction.

Mandaumin, Ont.
W. Storing, Brown Homestead, Mandaumin, Wyoming, is considering the erection of a residence.

Niagara Falls, Ont.
Work has been started on the erection of a residence on Bridge Street for Albert E. Goring, 4 Pine Street. Brick and shingle construction.

Ottawa, Ont.
John Wilson, care of F. Wilson, 793 Somerset Street, contemplates the erection of two residences on Irving Street and another on Bethany Street. Brick veneer construction, stone foundation, shingle roofing. Estimated total cost, $9,500.

W. J. Spratt, 157 Sunnyside Avenue, contemplates the erection of a residence, to cost about $4,500. Brick veneer construction.

B. A. Grison, 83 Bank Street, is having plans prepared for a bungalow to be built on Fentiman Avenue at an estimated cost of $3,500, and is also considering the erection of a number of residences to cost about $4,000 each. Stucco and brick construction.

Quebec, Que.
L. E. Auger, 39 St. Jean Street, is preparing plans for two residences for J. and Alcide Samson. Estimated cost, $7,000 each.

Raleigh Township, Ont.
George Davidson has had plans of a residence prepared by James L. Wilson & Son, 80½ King Street West, Chatham. Estimated cost, $3,000. Brick veneer construction.

Sorel, Que.
L. S. Robitaille, Phipps Street, contemplates the erection of four flats to replace those destroyed by fire.

St. Jerome, Que.
Charles Jouivet, 377 Rue Notre Dame, Maisonneuve, is building an addition to his residence, estimated to cost $4 000. Frame and plaster construction.

Thedford Mines, Que.
E. Lacerte, Thedford Mines, contemplates the erection of a residence, and is having plans prepared by L. E. Auger, 39 St. Jean Street, Quebec. Estimated cost, $12,000.

Toronto, Ont.
P. H. Finney, 79 Adelaide Street E., is preparing plans for three residences to be built on Kew Beach Avenue, for E. Elliott, 77 Vermont Street. Frame construction.

W. C. Charters, 808 Kingston Road, proposes to build a large number of residences on the Kingston Road, at an approximate cost of $50,000. Plans are being prepared by P. H. Finney, 79 Adelaide Street E. Frame and brick construction.

E. R. Machon, 168 Oakmount Road, has commenced the erection of a pair of residences on Boon Avenue. Brick construction, shingle, felt and gravel roofing. Estimated cost, $4,200.

Mrs. C. Ray, 583 Spadina Avenue, contemplates alterations to her residence for conversion into apartments.

E. J. Croker, 2t Alton Avenue, has commenced the erection of a pair of residences on Orchard Park Boulevard, estimated to cost $3,500. Smaller trades will be sub-let. Brick construction, shingle, felt and gravel roofing.

E. A. Wilkinson, 151 Balsam Avenue, is receiving tenders on the erection of a residence, estimated to cost $4,000. Brick construction, shingle roofing.

Ellis & Ellis, Manning Chambers, will receive tenders until March 15th for the erection of a residence on Radford Avenue for Dr. Gilmour. Estimated cost, $7,500. Brick construction.

Walkerville, Ont.
The erection of a residence on Kildare Road is contemplated by F. E. Allum, Detroit, Mich. Stucco construction.

CONTRACTS AWARDED

Georgetown, P.E.I.
Work will start in the spring on the erection of a residence for Benjamin Stewart. The general contract has been let to P. Bradley, St. Teresa, P.E.I. Frame construction, concrete foundation, shingle roofing. Approximate cost, $3,000.

Hamilton, Ont.
J. W. Gage, 507 Bank of Hamilton Building, has let the contract for masonry required in the erection of two residences on Belmont Avenue to A. Barnes, 53 Cheener Street, and the carpentry and roofing to George Culp, 227 Glendale Avenue. Estimated cost, $3,500.

The following contracts have been let in connection with the apartment house which is being built for G. A. Rivett, 811 King Street E.:—masonry and steel, D. Tope, 191 Robinson Street; carpentry, W. Bell, 113 Sherman Avenue N.; heating and plumbing, P. A. Moore, 939 King Street E.; electrical work, Culley & Breay, King Street West.

Ottawa, Ont.
D. L. Campbell, 6 Driveway West, is building a residence on Wilton Avenue, estimated to cost $8,500, and has let the contract for electrical work to E. Headly, 645 Echo Drive. Brick veneer construction, stone foundation, shingle roofing.

W. H. Craig, 245 Fourth Avenue, has commenced the erection of a residence on Carlyle Street, and has let the masonry contract to Beattie & Davidson, Renfrew Avenue, and the brick work to Peerless Brick Company, Ottawa South. Estimated cost, $4,500.

The contract for electrical work required in connection with the apartments in course of erection for W. H. Tate, Bank Street, has been let to P. Ackroyd, 416 Bank Street.

Westmount, Que.
Anglin's Limited, 65 Victoria Street, Montreal, have commenced the erection of a residence on Willow Avenue for T. A. Hubley, 4 Windsor Avenue. Tenders

are being received for electrical work. Estimated cost, $6,800. Terra cotta and plastic brick construction.

Power Plants, Electricity and Telephones

Beckwith Township, Ont.
The Township Council are considering the construction of about twenty miles of telephone lines during the year. Clerk, J. W. Robertson, Carleton Place.

Blenheim, Ont.
The Blenheim & South Kent Telephone Company propose to make extensions to their system. Particulars from C. B. Langford, Blenheim.

Calgary, Alta.
The City Commissioners will receive tenders until 4 p.m., March 15th, for the supply of underground cable. Specifications at office of the City Electrical Engineer.

Castleton, Ont.
The Cramahes Municipal Telephone Company propose to construct their system this year. Secretary, Herman Reynolds, Morganston.

Dashwood, Ont.
Plans are to be prepared at once for the construction of a transmission line between Dashwood and Exeter, with branches to Zurich and Crediton. Owner, H. Eilber, Dashwood.

London, Ont.
The City Council will shortly consider the installation of an ornamental lighting system on the breakwater at West London. Clerk, S. Baker.

Mersea Township, Ont.
The Township Council propose to construct a Municipal Telephone System throughout the Township. Clerk, A. Hairsine, Leamington.

Niagara Falls, Ont
The Hydro Electric Commission propose to let a contract for the supply of lamps and transformers during the year. Superintendent, George Foster.

Toronto, Ont.
Kerry & Chace, Limited, 550 Confederation Life Building, desire to receive prices and other information with regard to the following:—one generator, three transformers, two belted induction or synchronous motors, two air compressors, and one Lydner sharpener. Immediate delivery at Cordova Mines, Ont., is required.

Yamachiche, Que.
The Brunelle Furnace & Boiler Company, Limited, propose to install electric motors and to equip their machinery for electrical operation. Manager, A. Heroux.

Fires

Bout de L'Isle, Que.
The residence owned by Oscar Ribet has been destroyed by fire. Loss, about $8,000. Owner will rebuild.

Bridgeburg, Ont.
Fire has destroyed the residence of W. M. Hogg. Loss, $4,000.

Calgary, Alta.
Fire has destroyed the Central Methodist Church. Loss, $50,000, partially covered by insurance.

Chatham, Ont.
Fire has entirely destroyed the residence of Abram Turner and the residence and barn owned by John Turner.

Clarkson, Ont.
A large barn, belonging to W. G. Gooderham, 42 Elm Avenue, Toronto, has been destroyed by fire. Loss, $30,000, covered by insurance.

Dover Township, Ont.
The Presbyterian Church has been destroyed by fire. Loss, about $8,000. Pastor, Rev. Norman Lindsay, Concession 11, Dover Township, Chatham.

Lake Rosseau, Muskoka, Ont.
Fire has destroyed the Maplehurst Hotel, owned by Mrs. J. B. Brown.

Moncton, N.B.
A residence owned by Dosite LeBlanc, Emmerson Street, has been entirely destroyed by fire.

Montreal, Que.
A business block on St. Catherine St. West has been destroyed by fire. Owner, Fairman Estate, care of F. W. Fairman, 232 St. James Street. Loss, $20,000.

The residence at 313 Beaudry Street, owned by Edmond Porcheron, 636 St. Denis Street, has been destroyed by fire. Loss, about $5,000.

Fire has damaged the premises of the Canadian Metal Manufacturing Company, Limited, St. James and Richmond Streets, to the extent of $15,000.

Fire has destroyed the Bonaventure Station of the Grand Trunk Railway Company. Loss, $300,000.

Orillia, Ont.
J. A. Orton's planing mills have been destroyed by fire. Loss, $7,500, partially insured.

Fire has destroyed the Grand Trunk Railway Station.

Ottawa, Ont.
Fire has damaged the foundry of the Ottawa Steel & Iron Works, 137 Broad Street, to the extent of about $3,000. Owners will rebuild.

Port Hope, Ont.
Fire has destroyed five residences owned by W. R. Chisholm, Church St. Loss, $15,000, partially covered by insurance.

Sarnia Township, Ont.
The residence of Adam Storing, Concession 2, has been destroyed by fire. Loss, $3,000. Owner is considering rebuilding.

St. Catharines, Ont.
Two stores, owned by Marshall's, Limited, have been destroyed by fire. Loss, $18,000, covered by insurance.

Thorold, Ont.
The residence owned by Mrs. C. Baxter, Beidal Avenue, has been destroyed by fire. Loss, $5,000, partly insured.

Toronto, Ont.
Fire has badly damaged the premises of the Toronto Wood Turning Company and the Builders' Moulding Company, 95 Richmond Street West.

Welland, Ont.
The planing mills belonging to S. L. Lambert has been destroyed by fire. Loss, $25,000, partly insured.

Winnipeg, Man.
Fire has destroyed a factory building owned by J. A. Mullaberry, 76 Smith St. Loss, about $9,000.

Miscellaneous

Assiniboia, Man.
The Municipal Clerk, Frank Ness, Kirkfield Park P. O., will receive tenders until noon, March 15th, for all lumber required during the year.

Calgary, Alta.
The sum of $13,000, for the erection of two comfort stations, has been included in the estimates for the year. City Clerk, J. M. Miller.

London, Ont.
The Board of Control will receive tenders until 4 p.m., March 13th, for supplies required during the year, including cement, tile, lumber, gravel and iron castings. Specifications at office of the Engineer, H. A. Brazier.

Toronto, Ont.
S. A. Hager & Son, 703 C. P. R. Building, are receiving tenders on the supply of 3,000,000 of birch, 1-inch, 1½-inch and 2-inch.

Triple Island, B.C.
The Department of Marine & Fisheries, Ottawa, propose to build a lighthouse and fog alarm. Deputy Minister, A. Johnston, Ottawa.

CONTRACTS AWARDED

London, Ont.
The London Concrete Machinery Company, Limited, have been awarded a contract for the supply of two batch mixers for use at the new plant of the Imperial Oil Company at Point Aux Trembles, Que.

Commission Appointed to Advise on Panama Canal Slides

In compliance with a request from President Wilson, who is desirous that General Goethals have the benefit of the best assistance possible in solving the problem he has in hand, the National Academy of Science has designated a commission to investigate the subject of slides on the Panama Canal and to make a report to the President concerning them. It is expected that the commission will sail for the Canal Zone to-day.

Those appointed on the commission are: Charles R. Van Hise, president of the University of Wisconsin; Brig.-Gen. Henry L. Abbot, hydraulic engineer, of Cambridge, Mass.; John C. Branner, president of Leland Stanford, Jr., University; Whitman Cross, of the U. S. Geological Survey; John F. Hayford, director of the college of engineering, Northwestern University; Harry F. Reid, professor of geology at Johns Hopkins University; Dr. Charles D. Walcott, president of the Smithsonian Institute; Rolla C. Carpenter, professor of experimental engineering, Cornell University; Arthur P. Davis, chief engineer U. S. Reclamation Service, and John R. Freeman, consulting hydraulic engineer, of Providence, R. I.

Tenders and For Sale Department

Tenders Wanted

Tenders are invited for the erection of a Brick Veneer School House on the Town Line of Moore and Sombra, Lambton County. Plans and specifications can be seen at the house of F. K. Johnson, Secretary-treasurer, or C. O'Connors, Chairman of the School Board, Bickford. Tenders to be opened March 20th, 1916. 9-11

The lowest or any tender not necessarily accepted.

Notice is hereby given that the time for the reception of tenders for Lock Gates and their equipment, at East River Lock, N.S., near New Glasgow, is extended to **Monday, March 13, 1916.**

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
9-9 Ottawa, Feb. 24, 1916.—93423.

CITY OF BRANTFORD

Tenders for Road Oil and Sewer Pipe

Sealed tenders, addressed to Ald. Geo. A. Ward, Chairman of the Board of Works, in care of the City Clerk, Brantford, Ont., will be received till 12 o'clock noon on **Monday, March 13th, 1916**, for the supply of Road Oil and Sewer Pipe required by the City of Brantford during **1916**.

Specifications may be seen and forms of tender obtained on application to the City Engineer.

Each tender must be accompanied by a marked cheque payable to the City Treasurer for the amount called for in the form of tender.

The lowest or any tender not necessarily accepted.

T. HARRY JONES,
City Engineer.

City Hall, Brantford,
February 23rd, 1916. 9-10

Tenders for Special Track Work

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, March 14th, 1916**, for the supply and delivery of -

Special Track Work, for St. Clair Avenue Barn. Extension, Toronto Civic Railway, No. 36 (Recall)

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
9-9 Chairman, Board of Control.

TOWN OF BARRIE

Tenders for Road Oil

Sealed tenders, addressed to the undersigned, will be received until **Thursday, March 30th**, for the supply of Road Oil for the year 1916.

J. S. LAING,
Town Engineer.

Barrie, Mar. 6th, 1916. 10-11

For Quick Sale

One 1 yd. Steel Side Dump Car, never used; for 24 in. track, 3/16-in. plate body and hand brake $70.00

One 1 yd. Steel Side Dump Car for 24-in. track, used only one month, 12 ga. plate body, with roller bearing boxes. 40.00

Two 2 yd. Steel Side Dump Cars for 36-in. track; never used, 10 ga. plate bodies, roller bearing boxes. Each 65.00

B. E. BECHTEL,
9-10 Waterloo, Ont.

POSITIONS WANTED

Experienced Contractor and Practical Builder desires change. Would accept position as superintendent of construction, or travelling salesman. Thorough knowledge of all building material and contractors' supplies. Box 336, Contract Record & Engineering Review, Toronto, Ont. 9-12

Late News Items

Charlottetown, P.E.I

Tenders are now being received for the installation of a heating system at the First Methodist Church. Secretary, E. H. Beer, 134 Richmond Street.

Louiseville, Que.

Tenders on the erection of a church will be received until March 22nd by Rev. Canon P. N. Tessier, Louiseville. Architect, P. Levesque, 115 St. John St., Quebec. Steel, terra cotta and stone construction. Estimated cost, $150,000.

Merlin, Ont.

W. A. Barr is clearing the site preparatory to the erection of a store, estimated to cost $10,000. Architect not yet appointed.

Niagara Falls, Ont.

M. H. Buckley, 20 Ontario Street, will receive tenders until March 12th for the erection of a garage. Reinforced concrete construction. Estimated cost, $6,000.

Ottawa, Ont.

The City Council have let the following contracts for supplies:—plank and cedar, W. C. Edwards, Sussex Street, $6,310; vitrified clay pipe, Barrett Bros., Catharine Street, and T. Sidney Kirby Company, Sussex Street; sand, W. E. Beaton, Canal Basin; stone, Federal Stone & Supply Company, Sussex Street; castings, Thomas Lawson & Sons, Wellington Street.

The general contract for rebuilding the factory of Grant, Holden & Graham, 147 Albert Street, has been awarded to Charles Holbrook & Son, 425 Somerset Street. Brick construction. Approximate cost, $30,000.

Sarnia, Ont.

R. W. Fawcett, 152 Essex Street, is preparing plans for an addition to the school of St. Paul's Presbyterian Church. Estimated cost, $8,500.

St. Augustin, Que.

The School Board propose to erect a school at an approximate cost of $15,000, and are having plans prepared by L. E. Auger, 39 St. Jean Street, Quebec.

St. Hilaire de Dorset, Que.

L. E. Auger, 39 St. Jean Street, Quebec, is preparing plans for a church to be erected for the Roman Catholic congregation. Estimated cost, $14,000.

Wheeled Spout Aids Concreting of Levee Slopes

Concrete protection for the river base of a 1,600-ft. levee has recently been poured economically in alternate up-and-down strips by a light, sectional wheeled chute which delivered concrete from a mixer moved along the top of the embankment.

The dike will protect a thickly-settled section of Binghampton, N. Y., from floods on the Chenango River, which four times in recent years has inundated this part of the city. The entire levee is 2,600 ft. long, the earth portion being built across the smaller, westerly channel of the river to Comming's Island. The east channel and part of the island was dredged out with a dragline and removed with a steam shovel and cars to provide material for the embankment. Most of the bank required a 20-ft. fill, the maximum being 35 ft. This brings the top of the levee to 26 ft. above low water and 6 ft. above the highest recorded flood. The remaining section of the dike consists of a steel-sheet-pile section 475 ft. long and a 500-ft. concrete wall.

The 6-in. reinforced concrete slabs of the river face of the embankment were cast in alternate 10-ft. strips, using forms similar to sidewalk forms. They are carried down 4 ft. below low water mark. Although it was expected that dry mixture would have to be used, it was found possible to hold a thoroughly wet mix on the 2-to-1 slope. The sectional chute, designed and furnished by the Foote Manufacturing Company, which supplied the mixer, was supported on wheels which rolled on scantlings laid at intervals across the top of the forms. The slabs for this section of the work were reinforced 2 in. from the bottom with No. 41-gage woven wire mesh to minimize damage from ice jams. The 1,800 cu. yd. of 1:2:4 concrete laid on the levee slope cost $7.90 per cubic yard. according to John A. Giles, city engineer of Binghampton, who had charge of the project. Arthur L. LaRoch, engineer in charge, supervised the conversation of both sections, while H. W. Fitzgerald was contractor for the embankment section described.

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Vol. 30 **March 15, 1916** **No. 11**

Principal Contents

The War's Effect on the Trade Policy of the British Empire

ONE of the most revolutionary results of the war, so far as the British Empire is concerned, will be the utter uprooting of the old ideals of free trade, which have been so great a factor in the political and industrial life of Great Britain. Already the chief exponents of free trade in Great Britain have thrown their former beliefs to the winds and come out definitely in favor of radical changes of fiscal policy, so as to enable the Empire, after the war, to maintain the objects for which it has been fighting and to make it impossible for Germany ever again to obtain that international industrial and commercial preponderance that has enabled her to plunge the world into war.

There is now no room for doubt that Great Britain will never again return to the position she occupied before the war as an isolated free trade nation. Her eyes have been opened to the danger of free trade so long as there are, among others, nations like Germany that will take advantage of it to increase their strength and preparedness for war. The rulers of England to-day are working out the details of this problem and getting ready for the changed conditions which will follow the war. Even now, these changes are to some extent in effect. By the time the war is over England will have much of the necessary machinery in operation, a good deal of the legislation worked out, and the public mind well prepared for the new fiscal policy.

In many ways these changes will work out to the advantage of Canada and the other overseas parts of the Empire. For Canadians the duty is to consider what this change will mean to us, and to see to how great an extent we can co-operate so as to produce, under the new conditions, the greatest advantage both to ourselves and to the Empire. The outstanding business features of the period following the war will be reconstruction and readjustment: reconstruction of the countries which have been devastated, and readjustment of the business relationships and industrial activities which have been shattered by the war. A great deal of consideration has been given to the reconstruction problem. Readjustment of the business and industrial situation, however, has not been considered by the press in general to anything like the extent that it warrants.

* * *

In connection with Great Britain and Canada, and to a large extent also in connection with the allied countries and Canada, the readjustment of business relationships will be of great and vital importance. No single country in the whole world will be in the same advantageous position as Canada. When the war is over, having borne her share of the struggle she will be favored by the allied countries whenever there is a possibility of conducting trade with her. In the markets of Great Britain and France this will be a great advantage to Canadian manufacturers. It will give them the whip hand in all transactions in which Canadian goods can stand any chance at all.

Even when one looks at this question in a broad and general way he cannot fail to be convinced that of all the countries in the world, the one which will develop most rapidly and most substantially after the war will be Canada. Our agricultural and manufacturing products are nearly all of a class that will be in demand in Great Britain, France, Belgium and other European countries. Our manufacturing and producing capacity will be strained to the utmost, and those who have foreseen the situation and placed their affairs in such shape as to take part in Canada's great expansion will reap a greater harvest of business prosperity than they ever dreamed of in the days before the war.

* * *

To put the matter in as brief and simple a form as possible, Canada will, more than ever before, be the Land of Promise and the Land of Fulfilment. Her plants will be running night and day, her merchants will be busy from morn till night. Her farmers will be able to sell at good prices everything that they produce, and this prosperity will attract to the shores of Canada a great tide of immigration. From all parts of the world people will set out for Canada to share in its expansion. The immigration from the United States to Canada which started on an extensive scale only a comparatively few years ago will be renewed and greatly increased. Moreover, from the United States we will then draw not only farmers in large numbers, but a far greater number of merchants and manufacturers than we formerly drew. Manufacturers in the United States will be quick to realize that, if they want to share in the trade of Great Britain and the allied countries to the fullest extent, they must establish plants in Canada so as to be entitled to the preferential treatment which Canada will then obtain.

These are no idle dreams dictated by desire and unfounded on fact. Anyone who reads what is appearing daily in the press of Great Britain regarding the fiscal problem, knows that these views are warranted by the trend of public opinion in Great Britain. Free trade has been killed. The Manchester Chamber of Commerce, the historic hot-bed of free trade, has voted against it by 998 to 527. The greatest exponents of free trade in Great Britain have thrown it over. From now on, every man who thinks about the fiscal problem in the Old Country will think of it in terms of tariff protection. The working out of protection will involve many differences of opinion, but the great change has come about. The war has made protection the only logical policy for Great Britain. After the war, and to a considerable extent during the war, protective tariffs will come into effect and they will unquestionably include preferential treatment for the Overseas Dominions and reciprocity between the Allied Nations.

Cement Bricks

The following inquiries have been received from one of our readers:—

1. Do you think cement bricks and block are to stay?

2. Have they any advantage over the common clay brick?

3. Is a cement brick the better by being made on a machine of heavy pressure?

4. What is the advantage of a frogged brick? Do they lay better than plain pressed brick?

It is always dangerous to prophesy, but Mr. W. W. Pearse, C. E., city architect of the city of Toronto, has been good enough to pass an opinion on these questions, which we print herewith. We also invite further discussion in the hope that further light may be thrown on these interesting questions. Mr. Pearse is of the opinion that cement blocks are here to stay, because they appear to have several advantages over solid brick. Being hollow, they are warmer and drier, though the joints when filled in solid act as fair conductors and offset to some extent the effect of the air spaces. It is very generally accepted that a hollow cement brick wall is warmer in winter and cooler in summer than solid brick. Cement block has the disadvantage, however, of not having as good a bond as solid bricks because it has not the same amount of bearing surface. Therefore much depends on the type of building. If a heavy load is to be carried solid blocks should be used. Hollow cement blocks should be laid in cement mortar on account of the small bearing surface.

Cement brick or block should be better if made under pressure. They will be denser, with the resultant greater resistance to crushing, and should absorb less moisture.

Frog brick properly laid give a better key to the wall than plain brick. The trouble is, however, that unless he is watched the bricklayer will lay the brick frog side down, to save mortar. For this reason it is generally accepted that a wall of plain brick is practically as good as an ordinary wall laid with frog bricks. It is the general practice in the United States to use bricks without frogs.

When Are Concrete Roads Most Profitable?

By H. S. Van Scoyoc, A.M.S.C.E.*

Concrete roads are most profitable when they give better value per dollar of expenditure than any other type of satisfactory surfacing material. While improved roads create values that cannot be measured in dollars and cents, a commercial standard is the one most readily set up.

Constant Costs

With any type of improved highway there are certain expenditures which should remain practically constant regardless of the surfacing used. In all cases the cost of right of way and grading should be a permanent investment; if bridges and culverts are constructed with proper regard for future requirements and of suitable materials they should be practically a permanent investment. Drainage work and foundation courses usually require expenditures other than that of the first cost. Surfaces can never be considered as permanent; while there has been a tendency to neglect some of the preliminary work, where concrete is used it is not to be commended. In the opinion of the speaker the initial cost of concrete highways justifies more careful grading and drainage work than where a less permanent type of construction is used. For the purposes of this discussion, however, it will be considered that all types of permanent surfacing should have the same amount of money expended on the preparatory work.

Concrete roads are made up of cement, sand, stone and labor. The first cost of the concrete will vary as any or all of these items vary. The labor cost for mixing and placing will show the least variation possible. The materials will increase in cost chiefly as the distance from their source to the point of construction increases. For example, the cost in Wayne County, Michigan, where the same materials and same methods are used throughout the county, has varied from $1.04 to $1.70 per square yard, depending upon the length of haul.

Concrete Cheaper than Macadam

There are exceptional cases where concrete roads have been built for lower first cost than waterbound macadam. This happens where no suitable local stone is available for macadam, but local sand and gravel are suitable for concrete. It would also usually presuppose a thickness of macadam greater than that of the concrete. The first cost of cement concrete will usually be less than that for bituminous concrete, brick or other types of permanent paving. It may or may not be less than that for bituminous macadam. In any case, however, the initial cost is a small part of the whole story and should be considered as such. The total road cost can be considered as comprising: first, interest on the first cost; second, depreciation, and third, maintenance, which should include overhead charges for administration and use of machinery as well as the repair charges for materials and labor. In special cases other considerations than the yearly cost on the basis just mentioned may be deciding factors in the selection of the material, as the value of a comparatively noiseless pavement in the vicinity of hospitals or schools. In cities and towns ease in cleaning

*Chief Engineer Toronto Hamilton Highway, before Ontario Good Roads Association.

is important. In any case ease of traction is desirable as affecting not only the actual cost of transportation, but also the expenditure for repairs to vehicles.

Cost Depends on Locality

Any particular locality presents a problem that will give a definite figure if solved along the lines mentioned. As a general proposition, however, certain figures will have to be assumed. A single track road will be considered as nine feet in width and a double track one eighteen feet. Interest will be taken at five per cent., which is possibly low just at the present time, but ought to be sufficient in ordinary cases. In estimating depreciation the concrete will be considered to be satisfactory for use as a sub-base at the end of twenty years. Cases considered will be where local municipalities may be responsible for the entire cost of construction and of the maintenance as well as the other cases that may arise under the new Highways Act. As previously mentioned, the first cost of concrete highways will show a considerable variation, depending upon local conditions. For present purposes a figure of $1.35 per square yard will be used. It should be reasonably safe for most localities where reinforcing and steel protection plates are not used.

Depreciation and Maintenance

A word of explanation as to depreciation and maintenance. Concrete roads are a comparatively new type. Their life is not definitely known. I have seen one street laid twenty-three years ago on which the maintenance cost per year has been considerably less than $50 per mile per year, and there is no present intention of using it as a sub-base for any other type. Some of the Wayne County roads under very heavy traffic are nearly ten years old and are still in good condition. It seems to me that under average traffic conditions limiting the use of concrete to sub-base purposes after twenty years is conservative.

Cost Figures

As to maintenance cost, few figures are obtainable for twenty-year periods, but the report of the Committee on Methods and Costs of Maintenance presented at the Second National Conference on Concrete Road Building states that from present returns one-half cent per square yard seems a conservative estimate.

Roadway Nine Feet in Width

Township Road:

First cost is, 5,280 × $1.35 ... ... $7,128.00

Interest at 5 per cent. $356.40

$$\text{Depreciation } \frac{5{,}280 \times (\$1.35 - 0.75)}{20} = 158.40$$

Maintenance ... ... = 35.00

Total $549.80

Suburban Roads:

		First Cost	Depreciation		Maintenance	Total
Province	40%	$142.56	$63.36	20%	$7.00	$212.92
City	30%	106.92	47.52	40%	14.00	168.44
County	30%	106.92	47.52	40%	14.00	168.44
						$549.80

Main Roads:

		First Cost	Depreciation		Maintenance	Total
Province	40%	142.56	63.36	40%	14.00	219.92
Municipalities	60%	213.84	95.04	60%	21.00	329.88
						$549.80

Road Eighteen Feet in Width

Township Roads.

First cost, 10,560 × $1.35 ... $14,256.00

Interest at 5% $712.80

$$\text{Depreciation } \frac{10{,}560 \times (\$1.35 - 0.75)}{20} = 316.80$$

Maintenance 50.00

Total $1,079.60

Suburban Roads:

Say total cost is $20,000 per mile. Province is limited to $4,000 per mile, or 20 per cent. of construction cost

		First Cost	Depre'n.	Maint'ce	Total
Province	20%	$142.56	$63.36	$10.00	$215.92
City	30%	213.84	95.04	15.00	323.88
County	30%	213.84	95.04	15.00	323.88
Local Imp.	20%	142.56	63.36	10.00	215.92
					$1,079.60

Main Roads:

Province limited to $4,000 per mile.

		First Cost	Depre'n.	Maint'ce	Total
Province	20%	142.56	63.36	10.00	215.92
Municipalities	80%	570.24	253.44	40.00	863.68

These figures may look formidable, but I believe they are representative. Col. Edwin A. Stevens, Commissioner of Public Roads, State of New Jersey, in a recent article stated that with an average daily traffic of 400 vehicles, mixed motor and horse drawn, maintenance of macadam roads with bituminous dressing can be taken at $1,300 a mile, made up of interest $500 (rate 4 per cent.), depreciation $200 and repair charges $600.

Maintenance Cost of Macadam

The 1915 report of the Massachusetts Commission states that especially near the larger cities the maintenance cost of macadam with a bituminous dressing would easily be $1,000 or more per mile annually, this figure not including interest on first cost. In their 1914 report is the statement that the average cost of maintaining over four thousand miles of main county roads in England was $1,100 a mile a year and the average cost of maintaining nearly two thousand two hundred miles of road in and around the city of London was $1,680 a mile a year. The costs given include resurfacing or reconstruction (considered as depreciation in our previous discussion) as well as ordinary repair and maintenance. These figures do not include interest on first cost, however.

The various items mentioned should be carefully considered and properly balanced in deciding upon the particular type of surfacing for any one locality.

Traffic Census

In conclusion, just a word of caution as to depending upon a traffic census of an unimproved highway as a safe criterion of what an improved highway in the same locality will be called upon to carry. In 1908 a seven-mile road which connected Woodward Avenue and Jefferson Avenue, two trunk roads leading out of Detroit in the Wayne County system, was carrying a total of forty vehicles per day. A traffic census last year showed an average daily traffic of almost two thousand vehicles, with a traffic on Saturdays and Sundays of from four thousand to six thousand vehicles.

Tests on Canadian Commercial Brick

Obtaining reliable data on Canadian Building Materials to facilitate estimating and eliminate failures

By W. W. Pearse, C.E.

[Some interesting tests were recently carried out under the supervision of Mr. W. W. Pearse, C. E., city architect of Toronto, on the compressive tensile strength and absorptive qualities of various kinds of building brick. The results of these tests are contained in the following paper read by Mr. Pearse before the annual convention of the Canadian National Clay Products Association. It is understood these tests were made with a view to obtaining information on which a suitable building by-law for the city can be based.—Editor.]

Three bricks were taken in each case, one of which was planed down to an even surface and then placed in a machine and crushed. If there was any chance of it being uneven, it was embedded in plaster Paris. Then, when it came to the bending test, the bricks were taken and supported on supports 7 ins. apart and a central load applied. Following this there was an absorption test made. The samples were put into a furnace, dried, weighed, put into water, taken out and weighed again. (I may say here that the man making the test was not aware whose brick he was testing).

The committee of the American Society for Testing Materials classify the bricks under the following headings:

Class A.—Vitrified Brick—Compression not less than 5,000 lbs. per sq. inch; absorption not more than 5 per cent.

Class B.—Hard Burned—Compression 3,500 to 5,000 lbs. per sq. inch; absorption not more than 12 per cent.

Class C.—Common Brick—Compression 2,000 to 3,500 lbs. per sq. inch; absorption not more than 18 per cent.

Class D.—Common Brick, seconds—Compression not less than 1,500 lbs. per sq. inch; absorption no limit; not to be used in exposed work.

Class C and Class D are more the type of brick which I had tested. It was not necessary to test the ordinary hard brick, for I knew it was safe. We wanted the mercantile brick. This comes under the heading "Class C, common brick." For results, see Table I. In this table the number of brick tested is given first, then the percentage of absorption, the fibre stress and the crushing strength per square inch.

Now, taking the two different tests, we have the crushing stress and the bending stress. If you have what is called lime mortar, which is 1 to 3 mixture, it is very little use paying any attention to the bending stress. The wall would more or less act the same as a beam and have a tendency to open up at the bottom. Lime mortar is of no value in tension, therefore it would be no use considering the tension in the brick. In using lime mortar, you need not take into consideration the tensile strength of your brick, because lime mortar would give way in tension before the bricks could be pulled apart. The stress on the bricks would therefore come down to an angle of about 60 degrees. If, therefore, you are using lime mortar you can exclude the idea of fibre stress and get down to crushing. If you are using cement mortar of 1 to 3 mixture it will work very well. If you had a wall of this nature you could treat it as a beam and make it of much less thickness and depth, because cement mortar, if of good quality, would have an equal strength, approximately, of the ordinary brick in tension and adhesive value, and this would make the brickwork a more or less homogeneous mass.

Referring again to the American tests, they found that a brick wall well laid in lime mortar only sustained 13 per cent. of the crushing value of the brick. For cement mortar you could allow 25 per cent. It is therefore a question of cost. I found, on consulting with different contractors, that the matter of cost was one of importance. On 1,000 bricks laid, $1.70 was the cost of the extra sand, cement and labor; that is, 22½ per cent. extra cost on 1,000 of bricks at the present market value. But you get an extra strength of 92½ per cent. If you could act as pioneers to get the best value out of your products it would be good to have you advocate using as much cement mortar as possible. We had a bad accident recently at the University of Toronto, and it was the opinion of some of the experts that if cement mortar had been used in place of lime mortar it might not have happened. However, this was not proven. It seems to me, however, that for very little extra cost (you can add 10 to 15 per cent. of lime to make the cement mortar

Tests on Bricks.—Table No. I.

Number of bricks Tested	Average percentage of absorption	Average fibre stress lbs. per sq. in. Bending	Minimum crushing strength lbs. per sq. in.	Maximum crushing strength lbs. per sq. in.	Average crushing strength lbs. per sq. in.	Nature of Material
6*	8.1	1026	3555	6215	4453	Hudson Lorraine Shale.
13*	15.8	872	3420	6150	5160	Medina Shales.
7*	12.0	915	3080	6170	4141	Interglacial Clays (Good).
3†	20.6	649	2700	3540	2983	Redeposited Glacial Clays (Good).
17†	17.0	643	2070	4080	2818	Iroquois Clay.
6	10.9	388	1645	4640	2993	Sand Lime, Hydrated.
2	11.3	404	2275	3000	2638	Sand Lime, Quick Lime.
16		481			3920	Western Brick Co. Underburned.‡
	18.0	576			2584	Class "C" Common.§
	No limit	403			1739	Class "D" Common.§

* Hard brick; † Ordinary brick; § University of Minnesota; ‡ University of Illinois, Bulletin No. 27.

work easily) you would get that much additional strength.

Referring to the Western Brick Company's Unburned, Table I., we find that there were 16 tests made, which gave 3,920 lbs. per square inch for the crushing strength. You will notice that Canadian brick compares quite favorably with this. By comparing the crushing and tensile strength with the absorption percentage, it was found that there was no relation between them.

The important thing to this department is,—how much will a brick carry in a wall? There is a difference whether you use lime mortar or cement mortar. We have had no tests made of our large walls, so I had to fall back on the United States. One was by the University of Illinois. The authorities all agreed so very closely on 25 per cent. for cement mortar and 13 per cent. for lime mortar that I adopted this standard.

If, therefore, we want to know what each brick will carry in the wall all we have to do is to multiply the crushing stress per square inch by 144; this will give crushing load in pounds per square foot. Then if cement mortar is used, take 25 per cent. of this value and it will give the approximate crushing load per square foot in a wall that is about nine feet high. Then this result must be divided by whatever factor of safety you may desire to use. I think for a concentric load a factor of safety of five would be a fair figure.

Now, if lime mortar is to be used, it would be safe to take just half of the results given for cement, as we found that for brick laid in lime mortar that you could only use about 13 per cent. of the crushing value of the brick, or approximately half of what you can use when cement mortar is used.

I want you to understand that when we select these bearing qualities, I would like to not only submit the question to your organization, but also to the Canadian engineering societies, so that we can get the very best thoughts on the subject.

Erosion or Weathering

Erosion, so prevalent in many of our public and residential buildings, calls for some explanation of the cause. Almost invariably the material in question is a red sand face brick. The clay from which the bricks are made is either a surface clay or an interglacial deposit common to the neighborhood of Toronto. Like the stratified glacial buff burning clays, they contain a high percentage of combined lime carbonate; in some deposits over seventeen per cent. is present. The buff burning clay is easily vitrified under oxidizing conditions, and does not yield to the decomposing influence of the converted carbonate. The interglacial and surface red burning clays are not vitrifiable under oxidizing conditions, hence the erosion which is so prevalent. To render the lime content impotent in these clays, reducing conditions must be established in the kiln, and continued, until an incipient metallic fusion (often mistaken for vitrification) takes place, but as the fire range is so short greater care must be exercised in the burning of the ware. It would be well to note here that buff burning shale bricks are showing signs of distress through erosion in different buildings in the city owing to what might be termed underburned ware. Although the shales are highly vitrescible it is necessary that a temperature be maintained high enough to vitrify the ware. Incipient decomposition betrays itself in loss of color. Red or dark red bricks gradually change color until they assume the appearance of underburned ware which they really are. At this stage the sand face is lost and they absorb moisture from the air greedily and if not coated with a filler, as paint, quickly waste away. Needless to say that moisture absorbed from the atmosphere quickened the lime content into action which reduced the brick back to its original state, minus the carbonate.

Summary

1. Face brick, being of extra quality, were excluded in deducing the averages, Table I.
2. All the samples secured of brick made from Hudson Lorraine shale by the dry press process are face brick.
3. The weakness of the dry press shale bricks in centre load test in comparison with the wire cut shale bricks is noticeable.
4. The superiority of the shale hollow brick over the glacial clay hollow brick is sufficient to make a second classification advisable.
5. The great variation of the strengths of the bricks made from the glacial stratified clay by three different processes is so noticeable as to require a separate class for each, although but one sample of each was tested.
6. The Iroquois clay when burned in stove kilns gives an inferior grade of brick, the stiff mud bricks being apparently stronger than the soft mud bricks.
7. The interglacial stratified clay when burned in any form of down-draft kiln, gives good bricks by either the stiff or the soft mud process.
8. The sand lime bricks come from plants in which the materials used vary widely in quality. The average is therefore scarcely a reliable criterion for this class of brick.
9. The cement brick that was tested was not very old. A new test will be made.
10. Test No. 73 A, made upon a brick similar to that used in test No. 73 after being allowed to age for a longer time, shows that cement bricks tend to become stronger with age.

Setting the Pace in Contracting

An exceptionally expeditious piece of brick and concrete construction is just being completed by Anglin's, Limited, Montreal. The Williams Manufacturing Company, Limited, Montreal, recently decided to erect an addition to their factory on Bourget Street. Plans were drawn by Mr. J. Cecil McDougall, A.R.I.B.A., and it was desired to erect the building in the shortest possible time. The floor area of the addition is 6,600 square feet, and the building has a frontage of 71 feet. The original plans provided for a structural steel frame, with the steel fireproofed, and mill construction floors. After consideration, and in order to save time, it was decided to change the design to a brick and concrete structure, that is, a reinforced flat slab construction. In this way the firm were able to occupy the two lower floors by the time that would have been taken to manufacture the steel had the original plans been adhered to.

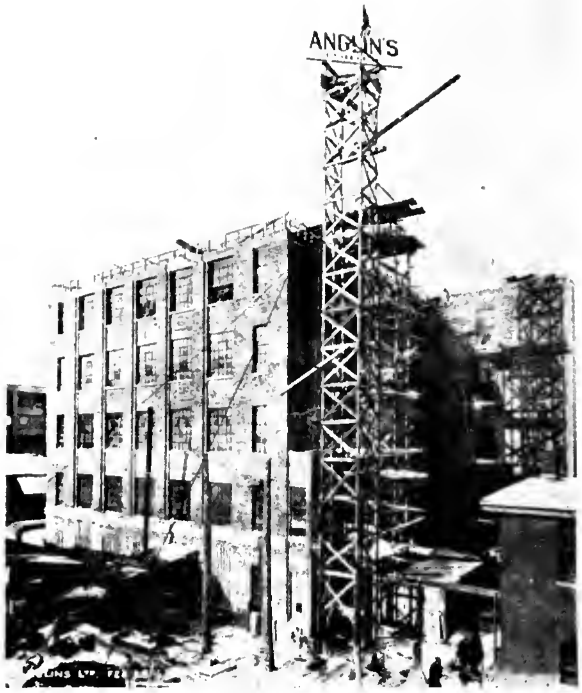
The contract was signed on January 4, one of the conditions being that the ground and first floors were to be ready for occupation on February 15, and the entire five storeys to be completed on March 15th. Operations were commenced on January 5, and the two first floors were ready three days ahead of the scheduled date, when the company commenced installing their machinery. Concrete was poured for the first floor on January 20 and 21; second floor, January 25 and 26; third floor, January 31 and February 1; fourth floor, February 4 and 5; and roof slab, February 11 and 12. The brick work was commenced on January 25, and the work was completed as follows: ground floor, bricked in on February 2; first floor, February 9; entire building, February 24. Present indications point towards the completion of the contract well in advance of scheduled time.

During prevailing cold weather the necessary precautions were taken to prevent the concrete freezing. All the materials for the concrete were heated by being placed over perforated pipes, through which steam was forced, the concrete being placed hot. The interior of the building was heated by salamanders, and in order to retain the heat the building was closed in with tarpaulins as the work progressed.

The building will, when finished, be an exceptionally good type of factory construction. The exterior is faced with Laprairie National brick, and the interior is lined with terra cotta, furnished by the St. Lawrence Brick Company, Limited, Montreal, and has a plastered cement finish. The cut stone used was furnished by John Quinlan and Company, Montreal. The floors are hardwood, laid on sleepers embedded in cinder concrete. White enamelled brick is used for the interior finish of all lavatories. All windows are metal, and were supplied by the Steel and Radiation Company, Limited. Darling Brothers, Montreal, supplied the freight elevator, and the Otis-Fensom Elevator Company, Limited, the automatic electric elevator. The iron stairs were manufactured by John Watson and Son, Montreal, Limited. The fire doors were supplied by the McFarlane-Douglass Company, Limited, Montreal.

The construction work was carried out by Anglin's Limited, with the exception of the roofing, which was sub-let to G. W. Reed and Company, Limited, Montreal, the sprinkling system and the electric lighting, the former being let to W. J. McGuire and Company, Limited, Montreal, and the latter to Philip Lahee and Company.

Anglin's Limited have also recently completed several other contracts before the dates specified. Simultaneously with the work described above, the firm put up a three-storey building for the Walter Blue Company, Sherbrooke, in six weeks, or two weeks ahead of time, and have also constructed a five-storey bale warehouse for the Canadian Cotton Company, Cornwall, in a very short time. Another instance is that of the plant of the Canadian Ingersoll-Rand Company, Limited, Sherbrooke, where an extension was finished five days prior to the contract time of ten weeks.



Brickwork completed—Feb. 28, 1916.

Buildings closed in with tarpaulins—Feb. 11, 1916.

Concrete for first floor being poured—Feb. 19, 1916.

Good Roads Congress and Exhibition

Third International and Good Roads Congress Spent Busy Week in Montreal—Delegates from All Parts of Dominion

Judging by the attendance at the Third Canadian and International Good Roads Congress and Exhibition, held in Sohmer Park, Montreal, from March 6 to 10 inclusive, there is a very decided awakening as to the value of good roads. Delegates were present from all parts of the Dominion, although naturally the majority were from the province of Quebec. The delegates included representatives of municipal authorities, contractors, engineers, members of governments and associations, government officials, and experts from over the border.

Throughout the Convention the attendance was exceptionally large, the papers, in English and French, were followed with interest, and the questions asked several of the speakers indicated that the problems dealt with were of real value to the delegates. As will be seen from our report, the papers covered a wide range of subjects; materials, construction, and maintenance being very prominent. Some of the best known experts from the United States were present, and their co-operation was cordially welcomed and acknowledged.

B. Michaud, Chairman

Mr. B. Michaud, Deputy Minister of Roads, Province of Quebec, the President, occupied the chair at the opening, and in welcoming the delegates said the hearty co-operation which they had given at past congresses was bound to be instrumental in carrying out one of the most important objects of good roads, which was the linking together not only of towns and cities, but also the citizens of the Dominion who had a common love for justice and true civilization. He especially welcomed the Ontario and American delegates, and said that the methods which were in operation over the border had been an incentive to the Canadians to carry out similar good work on the roads.

In formally declaring the Congress open, the Hon. P. E. Leblanc, the Provincial Lieut.-Governor, said that he did not know of any two agents greater in their effect upon human progress than good schools and good roads. The Provincial Government was engaged in improving the roads, and it was of special and valuable assistance to them to have such a Congress held so that they might be able to formulate a series of propositions regarding road-building on which could be based further building of roads with the aim of directing its road policy in the interests of the province.

Everybody Interested

Monsignor Roy, on behalf of Archbishop Bruchesi, and Bishop Farthing, both pointed out that their respective churches were interested in the good roads movement.

The Hon. J. A. Tessier, Provincial Minister of Roads, spoke of the benefits that accrued to the farmer, the merchant, the manufacturer, and the whole community through the improvement of the means of communication, and he was sure that the prosperity which marked the province would continue to increase as its highways were improved.

The Hon. J. E. Caron, Minister of Agriculture, said that the good roads policy was first initiated under his department. The Government had gone about its road policy in a systematic way, preparing the public for improvements by a system of education on the value of good roads, and the results had been more than gratifying. The congresses that had been held in the past had been a valuable aid in this respect.

The Hon. Jeremie Decarie, Provincial Secretary, Controller Cote, and Mr. U. H. Dandurand also spoke.

During the session the President read a telegram from Mr. W. A. McLean, Deputy Minister of Highways, Ontario, expressing regret at being unable to be present owing to illness. He declared that to make Canada famous for good roads was a work of patriotism worthy of the greatest support, and requiring the earnest co-operation of every province and municipality from the Atlantic to the Pacific; to that end the Good Roads Congress had his best wishes for success.

At the banquet in the evening, the President stated that the Provincial Government's roads department was always willing to receive road engineers from all over the province, feeling that if they were advocates of the construction of certain roads they were putting forward something that would benefit the country as well as themselves.

Honesty of Public Contracts

The Hon. Jeremie Decarie emphasized the importance of everyone connected with the movement being honest. He would like to see on the order of the day, a paper read on the honesty of public contractors. Every public administration needed workers and they needed experts, but more than that they needed that the contractors should have a conscience that was equal to the task they had to perform for the public. Let their work be honest, whether it was for roads, or public buildings, for the sake of national security. Roads were something common to all; let the contractors be fair and honest to the country that awarded them the contracts.

Mr. S. L. Squire, president of the Ontario Good Roads Association, referred to the importance of a national system of good roads linking all the provinces.

Mr. T. Adams, town planning expert of the Conservation Commission, said the Federal Government should be in closer touch with the roads movement. The Commission of Conservation was interested and anxious to help in every way. Problems of standard road construction and other details needed to be thoroughly discussed, and above all there was the need for system in planning roads. The public authorities were spending a vast amount of money without having a properly considered scheme for the planning of the roads. They had no settled principles on which to proceed, and had no regard to future developments.

The President explained that the province had a plan in its building of roads, that there was a system of trunk roads between cities for heavy and constant traffic, and secondary roads in the municipalities in addition. He pointed out that at the commencement of the Government's Good Roads campaign it was faced with a situation where the need of roads was desperate, and it had to have roads built where they were needed by the citizens. In spite of that handicap, it had linked up the needs of the province in this way with a general plan.

Mr. Adams mentioned that his reference to the lack of planning referred to the cities more particularly—the provincial authorities were carrying out their road policy on a good plan.

Mr. J. W. Levesque, M.L.A., Hon. J. A. Tessier, and Alderman Boyd were among the other speakers, the last named referring to the good work done in Montreal by Mr. Paul Mercier, the city's chief engineer.

The real business commenced on March 7, when the morning session was presided over by Mr. B. Michaud. The first paper was by Mr. J. W. Levesque, M.L.A., who spoke on "Provincial Aid for Road Building." He reviewed in detail the road programme of the Province of Quebec during the last fifteen years, stating that the chief work in road improvement had been accomplished during the last ten years. In 1841 they commenced the decentralization of the laws governing roads with the creation of municipal councils, and from 1845 to 1860 the laws formed the base of the actual system. Mr. Levesque spoke of the excellent work of the Provincial Government in making main highways, notably the King Edward Boulevard, and the Sherbrooke-Derby, Montreal-Quebec, and Levis-Jackson roads. He insisted upon the urgency of provincial governments giving aid to local authorities in making and maintaining roads.

Mr. S. L. Squire briefly discussed the difference between the systems of Quebec and Ontario; in the former the municipality was the unit, and in Ontario the county was the unit. The roads problem was a vital one. In addition to the contribution of 40 per cent. paid to such Ontario counties as went into the scheme, there was one of 20 per cent. for upkeep, the balance being paid by the municipalities. The fact that Mr. W. A. McLean had been appointed Deputy Minister of Highways indicated that Ontario was looking forward to the province taking its place in the sun so far as good roads were concerned. There was a quickening of interest in that province. At a future congress it might be possible to compare the results under the different systems of Ontario and Quebec.

Macadam Road Maintenance

By W. Huber, A.M.C.S.C.E.

Mr. W. Huber, A.M.C.S.C.E., Ontario Highways Department, Toronto, opened the morning session with a paper on "Macadam Road Maintenance." The changing character and the increased intensity of modern traffic have brought about a marked change in the methods of maintenance, and have advanced the question to a position of equal importance with that of construction. Formerly the road builder looked on the completion of the road as the end of his work. To-day it is only the beginning. The present tendency is to consider no road or pavement permanent, for no builder of highways would claim the ability to construct a road or pavement that will withstand the severe strain imposed on it by present-day traffic.

Commence Maintenance

Maintenance should begin on the day the road is opened to traffic. Realizing that a well-built road will require much less expenditure to keep it in good condition than one built to a lower standard, it will be well, before commencing construction, to consider carefully the relation between original cost and the cost of subsequent maintenance. It is well to remember that a moderate increase in the cost of construction may materially lower the annual maintenance charges. It will, for instance, permit an increase of from two to three inches in the depth of stone, and a corresponding increase in the strength of the road, or it will provide an extra inch or two of stone, and in addition a bituminous carpet coat to protect the surface and prevent dust. The latter will result in an improved road, and it cannot be denied that the annual maintenance cost of such a road will be materially reduced.

Annual Cost of Maintenance

The annual cost of maintenance of macadam roads may be quoted roughly as from one to ten cents a square yard, depending on conditions such as the nature and intensity of traffic, the quality of material, character of subgrade, excellence of drainage facilities, and principally the efficiency of the maintenance organization. Efficient maintenance consists of more than keeping the travelled roadway smooth; it must include careful protection to the metal surface, and also the earth shoulders and subgrade from the numerous agencies which tend to destroy them. Such a programme will also include careful attention to the drainage facilities and the improvement of these wherever possible. The use of the split log drag is being emphasized in connection with the maintenance of earth roads. It may also be used with profit on earth shoulders of macadam roads, both in keeping them smooth and maintaining a proper camber and in preventing the growth of weeds.

Destructive Agents

Some of the destructive agencies to which the road is subjected are almost entirely preventable, and may with proper construction be almost eliminated. Of these the chief is probably the action of water and frost in the subgrade. With proper drainage there will be no water under the road, and where there is no water there is no damage from frost. Other agencies, however, such as abrasion and pulverization, caused by horses' feet and vehicle wheels, the shearing action of fast-moving automobile tires, and the chemical actions set up on the weathering of the stone, cannot be entirely prevented, and protection against them consists mainly in minimizing their effects. Much of the wear and damage sustained by roads subjected to increasing heavy traffic are due to the inconsideration of users of the road. To counteract this negligence education will in some cases be necessary, while in others legislation will have to be brought into play. In the former class may be mentioned a tendency to drive in a single track, thereby hastening the formation of ruts. This is frequently encouraged by building narrow roads with high crowns, and a partial remedy is found in widening the metal portion and reducing the crown. In the latter case the assistance of the law to limit the speed of automobiles and the weight and speed of motor trucks would be justified.

When all is said on the causes of road deterioration, and the methods of preventing it, the fact remains that road maintenance consists largely of labor expended on the road surface itself. No matter how good the construction, wear will occur, and it is the chief object of maintenance to take care of this wear before it goes so far as to require repair work. Ruts and depressions will form, especially in a newly-built road which has been laid on an earth subgrade. The second season is usually the road's worst time.

Repairing Ruts

There are two general methods of repairing ruts, either of which will be found effective and inexpensive. The first consists in spiking up the ruts with a road roller, using short spikes, and refilling with new stone from 1 inch to 1½ inches in size, carefully placed and in sufficient quantity to restore after consolidation the old cross-section. This is then rolled and bound with screenings and water, as in the case of the original road. The second plan eliminates the loosening of the road surface, and depends on the use of tar or asphalt to keep the new stone in place. Ruts are first thoroughly swept, the surface painted with bituminous material, new stone placed, and the whole rolled. A small quantity of bituminous binder is then applied, and the whole surface finished with stone chips and rolled again.

Oil as a Maintenance Material

The use of oils on road surfaces is usually considered in connection with the prevention of dust, but the systematic treatment with a good asphaltic oil ranks with the most efficient methods of road maintenance. The most lasting, and generally the most satisfactory, treatment of a macadam surface—particularly when subjected to much motor traffic—is found in the carpet coat. This consists of a thin covering of bitumen filled with stone chips, pea gravel, or coarse sand, applied in a layer of from one-eighth to one-half inch thick. While more expensive than a treatment with light oils, a carpet coat is usually cheaper in the end, owing to the greater durability of a single application and the better condition in which the road is preserved. When properly applied a carpet coat will last, with a small amount of maintenance, from two to five seasons.

Use of a Carpet Coat

The cost of a heavy carpet coat such as described will usually be from eight to ten cents per square yard. Including the cost of maintenance, the actual cost of this form of road protection in ordinary cases will be from two to four cents per square yard. This cost will be somewhat increased on main travelled and suburban roads, in which case it may be as high as from six to eight cents per square yard per annum.

The size of stone chips required will vary with the grade of bitumen used, from coarse sand to ½-in. stone. Whatever size is used, it must be free from dust. Since it is to constitute the actual wearing surface of the road, it should be carefully selected and properly applied. Trap or granite chips should be used wherever obtainable at a reasonable price. First-quality limestone is next in preference, while pea-gravel and coarse sand may also be used.

In order that the benefits of the carpet coat as described may be continued, great care must be taken to keep the surface completely covered. The bare spots must not be allowed to develop, or pits will form. When the bitumen has worn or peeled off the surface, the stone beneath, robbed of its bond, will ravel, and a pit is the result. The scheme of maintenance should provide for a frequent and systematic inspection of all treated roads, and the application of a small quantity of bitumen and stone chips of the same grade as those originally used to any spots where bare stones are showing.

Patrol System

The mention of constant attention introduces the subject of patrol work in connection with road maintenance. The employment of patrol men on the main roads is now quite general, and it remains to have this system extended to cover the less important roads, which must also, in the interests of economy, be kept in a state of first-class repair.

At the first sign of wear or deterioration steps should be taken to repair it in order that the work may be done as cheaply and expeditiously as possible. While attention to the travelled roadway is perhaps the most important of the patrolman's duty, the maintenance of drainage, and its improvement where practicable, are also of vital importance. All side ditches and culverts must be kept open and free from rubbish; weeds on any part of the road allowance should be kept down, guard rails repaired, approaches to bridges and other property promptly repaired.

In efficiency the patrol system has already proved its worth, and the organization of such a system, suited in detail to local conditions, will result in better kept roads at less cost.

The Town Planning Movement

By Thomas Adams

Mr. T. Adams spoke on the subject of town planning. The good roads movement in Canada, he said, was chiefly concerned with roads in rural municipalities. The time seemed to have come when consideration should be given to the need for extending the scope so as to include all authorities and municipalities interested in road transportation in any class of area. The chief trouble in road transportation was perhaps concentrated in the semi-rural areas, where all surrounding traffic radiated towards a given centre. Co-operation between the city and the rural municipality was needed. That was why the city as well as the country districts should be interested in the good roads movement, and why the extension of the scope of the organization was desirable. Referring to the interest the farmer had in good roads, Mr. Adams said that more must be spent in future in getting good roads, and the farmer would have to bear his share of the cost. Up to the present the fault had been largely in the direction of providing too many roads. It had seemed as if they thought by putting road reservations on the map and calling them roads they would become roads without artificial aid. Provincial planning must precede town planning. The farmer in Canada had not yet begun to interest himself in town planning because he had not seen how it affected him. The planning of road widths was required so that more importance would be attached to the principal thoroughfares and less space given and money spent on minor roads in sub-divided districts. They could not afford to give a greater average width to streets than 60 to 65 feet, but they could arrange so that more width would be thrown into main thoroughfares and less width into streets of short length not required for through traffic. The question of width should have relation to the traffic purposes of a street, and farmers would gain as much as any other class from the proper planning of the roads. Whatever standard of width might be fixed in a given area, they could vary the width of the building lines so that no building should be erected nearer than 100 feet to a main thoroughfare, thus enabling them to widen such a thoroughfare in the future if necessary. In most rural municipalities there was still time to plan so as to secure a most sensible adjustment of road widths according to their needs and ability to pay. If 60 feet or 66 feet was a sound minimum for minor streets it was an absurd width for main thoroughfares. The use of road frontage for different classes of buildings should be considered with more care. Manufacturers selected sites in rural areas without regard to the effect of their traffic on roads or the increased burden of taxation they would put on the community. The fixing of certain areas for residences and others for manufacturing was even more important in rural areas than in cities.

After discussing other aspects of town planning, Mr. Adams stated that they should all receive urgent consideration by rural municipalities in town planning schemes. He suggested that the Province of Quebec should pass a compulsory town planning law, giving local authorities power to lay down schemes which would fit in with the general schemes of roads in the province. He also suggested that a department of municipal affairs should be created which should give its especial attention to finance, unemployment, standards of value, planning and construction.

Hot Mix Method of Bituminous Construction

By F. P. Smith, C. E.*

"The Hot Mix Method of Bituminous Construction, Using an Asphaltic Binder," was the subject of a paper by Mr. Francis P. Smith, Ph.B., M.A.S.C.E., M.A.I. C.E., New York, on Tuesday afternoon. Due to the wide variety of bituminous pavements known at the present time, it is always possible to select one type which will satisfactorily answer any given set of climatic and traffic conditions. Bituminous pavements, therefore, come nearer to being the universal ideal type of pavement than any other which have yet been devised.

Bituminous Pavements

Bituminous pavements are smooth, non-productive of dust, almost noiseless, waterproof, non-absorbent and easy to clean. They are capable of sustaining very heavy traffic, and last well under light traffic. They are easy to repair, and offer slight resistance to traffic. Their slipperiness in moist, drizzly weather is largely due to the presence of a thin film of mud. While sheet asphalt will sustain a very heavy traffic, this statement applies more especially to traffic largely composed of quick moving, light to medium loaded vehicles. Wood block and granite block pavement will last longer under dense, slow-moving, heavily-loaded traffic. On account of its smoothness, sheet asphalt pavements are not suitable for use on excessive grades. With a fair amount of traffic it can be used as high six per cent. Where traffic is heavy a three or four per cent. grade is usually considered the limit.

Mineral Aggregate

Depending upon the size of the mineral aggregate used, sheet asphalts may be considered as bituminous mortars or bituminous concretes differing from ordinary mortars and concrete in having a cementing material which is plastic and which may be classed as a semi-fluid or semi-solid. Great care should be taken in the selection of the mineral aggregate and its grading. Pavements produced by these mixtures are to a certain extent malleable and yielding. This quality of flexibility or plasticity makes it necessary to provide a stable foundation. If the foundation is unstable and sinks, the pavement will gradually sink with it, thus forming a depression where water will collect and eventually destroy it.

Hot Mix Bituminous Pavements

Hot mix bituminous pavements differ from each other chiefly in the size and kind of mineral aggregate, the bituminous cement or binder being substantially the same in each case. The coarser the aggregate used the rougher will be the surface of the finished pavement. Generally speaking, the heavier the traffic the finer should be the mineral aggregate used, owing to the fact that the coarse particles are more liable to fracture than the smaller particles. When fracture takes place to any considerable extent rapid deterioration of the pavement will ensue.

Foundation

The character of the foundation required will depend upon the traffic, climate, and character of subsoil and drainage conditions. In cold climates, where the ground freezes to a considerable depth in the winter, and the spring thaws produce unstable conditions in the subsoil, the foundations required must be stronger than in climates where there is little or no frost. A number of different types of foundations have been successfully employed, such as old macadam, broken stone rolled dry or cemented together with some form of bituminous cement, old cobble stone, old brick or asphalt blocks, bituminous concrete, natural cement and Portland cement concrete. Before using any of these types its history, and more particularly its condition in the spring of the year, should be investigated. A sufficient number of test holes should be put down to determine the depth of the foundation, and provision made for a proper under and side drainage. Where depressions are to be filled the road should be cleaned and slightly loosened to ensure a proper bond with the filling material.

Selection of Aggregates

The mineral aggregate constitutes from 75 to 80 per cent. of the pavement, and takes practically all the wear resulting from traffic. It must therefore be se-

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lected with a great deal of care. It must have clean grains or particles, which should be graded from coarse to fine so as to make the pavement a maximum density. The surface of the grains or particles must be of such a character that the bituminous cement will adhere satisfactorily to them. Sand, gravel, broken stone, or slag, or combinations of these, are the materials generally used in this type of pavement. Sand should be clean-grained, hard, and moderately sharp. Gravel should be clean-grained, hard, and free from adhering clay, with a rough, pitted surface, and gravel containing a large percentage of flinty particles should be avoided. Broken stone should be freshly crushed, preferably in cubicle-shaped particles, the size and hardness required depending upon the traffic. Hard, dense, basic slag is to be preferred; it should be stable when exposed to the weather, and not show any tendency to disintegrate.

Filler and Binder

The filler should be a finely-ground limestone or Portland cement, the latter being preferable for mixtures designed to carry heavy traffic. The bituminous binder, or asphaltic cement, must posses such properties that it will firmly bind together the mineral particles and resist the disintegrating action of traffic and the elements.

Mixing Plant

The plant used in the manufacture of paving mixture is a very important element in the success of the pavement. A uniformly good mixture cannot be turned out by an imperfect plant. Great care must be taken not to overheat either the mineral aggregate or the bituminous cement, as this will injure and harden the latter, while too low a heat will result in imperfect coating of the mineral particles.

The standard sheet asphalt construction of the present day is one and one-half inches of binder and one and one-half inches of wearing surface. The binder should be of a close type—that is, should contain approximately 25 per cent. of material passing an 8-mesh sieve. The binder should, of course, be thoroughly compressed with a steam roller before laying the wearing surface on it. Lack of compression will produce an unsatisfactory foundation for the wearing surface, and binder which is too cold, or made with too hard an asphaltic cement, or an insufficient quantity of asphaltic cement, cannot be properly compressed into a dense, tough mass. Before laying the surface mixture on the finished binder course the latter should be dried and swept clean of dirt, otherwise the laying of the wearing surface will not adhere properly to it. Extra care should be taken to ensure a proper union between surfaces laid on successive days. The joints should be bevelled and freshly cut away, unless the rope joint or similar method is employed. Great care should be taken not to leave any lumps or depressions where the joint is made.

Handling and Care of Machinery

Mr. E. Fafard, superintendent, plants branch, Highways Department, Province of Quebec, read a paper on "The Handling and Care of Machinery." He referred in detail to the plant at Quebec, and to the methods by which the machinery was cared for and protected from the weather when not in use. He outlined the routine of his department, and insisted on the importance of carefully looking after repairs so that machinery could be economically handled.

Road Maintenance, Materials and Methods

By W H. McConnell

William H. McConnell, Chief of the Bureau of Highways and Street Cleaning, Philadelphia, delivered an address on "Road Maintenance, Materials and Methods." A good organization is essential in maintenance, as it is practically impossible to continuously and systematically maintain pavements and roads in first-class condition in an economic manner without good working organization. Maintenance organization and construction organization should not be separated, as separate organizations are apt to shift responsibility as to whether the construction or maintenance division is responsible for any unsatisfactory conditions that may arise relative to the pavement.

Success Depends on Details

It is the intimate knowledge of the details of both construction and maintenance, not considered separately, but in their relation to one another, that is so desirable as a future guide in highway engineering. Every engineer engaged in highway work appreciates the fact that there is no such thing as a permanent pavement for either city streets or country roads; consequently, in addition to the cost of construction, maintenance repair charges during its life must be included in the final cost, and is a most important factor in the selection of a pavement. The main and most perplexing problem of a highway department is, or eventually will be, that of maintenance. If a large percentage of the roads or pavements are already constructed, then maintenance predominates.

Maintenance Organization

It is of course a much simpler matter to cope with this problem of maintenance where the work involved is such that it can be controlled from a central office without delegating the responsibilities to divisions and subdivisions of the organization. This is due to the tendency among the engineers to be lax in attention to details of an apparently simple and routine nature. They are apt to overlook the fact that it is no trick to construct a pavement, as in supervising this work they are simply following a standard well-defined specification; whereas in maintenance work there is no such specification to follow, the success depending upon attention, to a certain degree, to the daily routine and petty details that present themselves. The difficulty of impressing upon the supervising force the importance of this close personal attention to detail in connection with the care of pavements is probably the most important single factor in the operation of a large highway department.

Classification of Work

Road maintenance may be grouped under the following classifications: Routine maintenance, general maintenance, and emergency maintenance. Routine maintenance includes such work as the regular street cleaning in municipalities, or the cleaning of country roads and gutters, or any work that is more or less routine, and should be performed under a definite schedule. The amount and schedule of work and the force necessary to perform it can be determined upon in advance and carried out in a systematic manner under a regular organization, more or less military. General maintenance includes repairs to streets and roads, and involves different characters of work, each requiring special knowledge on the part of those engaged in the actual performance. This branch is generally classified under the three following heads for repair work: (1) Block pavement repairs; (2) Bituminous pavement repairs (mixing method), sheet asphalt, bituminous concrete, etc.; (3) Country roads, macadam, gravel, etc., bituminous surface treatment, and earth road repairs. Further sub-divisions can be handled by those directly in charge of the different classes of work coming under these divisions by training laborers for the particular character of work to which they are assigned.

Emergency Maintenance

The third classification, or emergency maintenance, consists of such work as snow removal and taking care of extensive washouts, both of which require an emergency force, as work of this character must be performed at once, and necessitates putting on an indefinite number of men, depending upon the volume of the work, usually for only a short period of time..

These are some reasons why the maintenance problem is the most difficult one in the highway department. Construction work, in the first place, is usually carried on under contract, and all the cares and troubles relative to the labor situation are put up to the contractor, while in the maintenance work the burden of responsibility is up to the officials of the department, not only in so far as the character of the work is concerned, but also for the control of the organization engaged in its performance.

Maintenance Systems

The general methods employed to maintain a system of highways in good condition are the patrol method and the gang method. The patrol method usually consists of having a man with a team and a repair equipment control and be responsible for making repairs to a certain definite length of highway. The gang method consists of sufficient gangs being employed and equipped with all the materials to make repairs wherever ordered. It would seem that the reporting of the necessity for repair by a special patrol inspector, and the making of these repairs by a specially trained gang, would be the better method.

Mr. McConnell dealt at some length with the methods of bituminous surface treatment used in the city of Philadelphia suburban and country macadam and dirt roads, giving figures as to cost and upkeep for the year 1915.

Road Maintenance in Canada

In conclusion Mr. McConnell pointed out that before long the maintenance problem in Canada would be looming up larger and larger every year. He pointed out the splendid opportunity Canadians had to avail themselves of the experience gained from the failure in other localities where there has been a great deal of highway construction. Summing up, he said it would not be an unfair statement to say that the failures in highway construction have been very much exaggerated. The trouble has been principally, however, the failure to maintain the roads and pavements after they have been constructed.

Cost of New York's Roadways

Mr. Fred W. Sarr, Deputy Highway Commissioner, New York State, read a paper on "The Cost of Maintaining New York State's Highways." After pointing out that the State had paid in 1915 the sum of $4,210,575 under the head of maintenance and repairs, Mr. Sarr gave the following statistics of the average expenditure for maintenance, repair and reconstruction per mile per year for each of seven types of road; 193 miles of gravel roads cost $955 per mile; 2,298 miles of water-bound macadam roads cost $1,055 per mile; 2,387 miles of bituminous macadam, penetration method, roads, cost $510 per mile; 63 miles of bituminous macadam, mixing method, roads, cost $181 per mile; 295 miles of bituminous concrete roads cost $1,050 per mile; 84 miles of first-class concrete roads cost $129 per mile; 291 miles of block pavement roads cost $190 per mile. The 5,611 miles of all types cost $750 per mile.

Legislative Aspect of Road Construction

By A. C. Emmett

Wednesday, March 8

At the first session, on March 8, the chair was taken by Mr. L. Howland, of Toronto. The first speaker was Mr. A. C. Emmett, Winnipeg, whose subject was "The Legislative Aspect Regarding Road Construction." For many years, he said, the road grants made were very meagre, but many provincial governments had now passed Good Roads Acts and the various municipalities could obtain substantial grants towards the carrying out of a definite and well defined plan of road improvement in the country districts. In the Province of Manitoba the Government gave a grant of 50 per cent. of the total cost of construction of all permanent roads, and paid one-third of the cost of dirt roads. No provision was made, however, for maintenance, which was a weak spot in many Road Acts, and the result was that often roads that were well constructed were ruined through the lack of funds to maintain them. There should be a provision in the Acts compelling municipalities to make some provision for maintenance for a period of time equal to that of the bonds which were issued in payment of the construction work.

There was no proper expert supervision of the road work, and to obtain this there must be an absolute change of system. He suggested that the roads of the country be divided into three classes: (1) Dominion roads—main highways—which should be built and maintained at the expense of the Federal Government, the money being paid from the Consolidated fund; (2) main roads but of secondary importance, which should be under the control of the Provincial Governments and paid for by them: (3) municipal roads, which would be feeders, and connected with the two other classes. In Manitoba they had annual split log competitions, supported by the provincial Good Roads Association. The Government this year were giving a special grant enabling the competitions to be extended over an area of 1,000 miles of demonstration roads. There was a difficulty under the Statute labor law in getting work done at the time it would give the best results.

A paper on "Gravel Roads," by Mr. Gabriel Henry, chief engineer of highways, Province of Quebec, was then read.

Highway Bridges

Mr. Lucius E. Allen, C. E., engineer for Hastings County, Ontario, read a paper on the construction of highway bridges. Mr. Allen dwelt on the consideration of the design and construction of highway bridges as a component part in any scheme of highway development.

Bridge structures should be so restricted as to be practically permanent. This requires not only careful designing at the start, but also the judicious selection of the materials to be used. Mr. Allen spoke of the lack of attention paid to securing a good foundation, with its resulting effects, and also on the determination of the size and type of piers and abutments. The balance of the paper was given over to the selection of the type of bridge, its cost, maintenance, and artistic design. It is gratifying to note that great advancement has been made within the past few years in the methods of bridge construction, and when the great highway from the east to the west is begun (as we believe it will be) the construction of these bridges will conform in beauty and permanency with the highway itself. Mr. Allen's paper will appear in full in an early issue of the Contract Record.

Gravel Roads vs. Macadam

By Gabriel Henry

Gravel Roads

"Gravel Roads" was the subject of a paper read by Mr. Gabriel Henry, Chief Engineer of Highways, Province of Quebec. The nature of the top course to be adopted for a road depends more than anything else upon the traffic which it is destined to accommodate. The cost of top courses varies according to their qualities and powers of resistance, and the more solid and durable they are made the more expensive, as a general rule, they are. Outside of cities and trunk roads there are a number of less important roads, generally known under the name of earth roads, gravel roads, and—the most important of them—stone, or macadamized roads, according to the nature of the top course employed. When the soil is of good quality and stoney they are maintained as earth roads. Where there is good gravel, as frequently happens, it is sometimes preferable to make use of it. Yet, even when stone is abundant, it may be advantageous in some cases to prefer gravel—provided, of course, that the volume of traffic does not exceed certain limits.

Drainage

Before gravelling a road, and when all the principal earthworks have been made, and the road straightened, the curves improved, and the bridges and culverts constructed, a perfect drainage of surface water, and the suitable drainage of subterranean water, should be provided. These two conditions are indispensable for any road, no matter what covering may be chosen for it.

Laying the Gravel Covering

There are two principal ways of laying gravel: (1) covering the entire road width between the ditches with one layer, which is given a fixed thickness in the centre, gradually diminishing towards the sides; (2) spreading a layer of gravel over the centre of the road for a determined width with earthen shoulders three or four feet wide at each side to keep the gravel in place. In this case the thickness of the layer is uniform over all its width, or only slightly deeper in the centre. For heavy traffic this latter system is the best, but is more expensive. The average thickness of the layer of gravel depends upon the resistance of the soil and the importance of the traffic. A good gravel on good solid ground may be reduced to an average thickness of four or five inches, measured after settlement. In cases of ground with less power resistance the gravel may be as thick as twelve inches or more.

When stone of a good quality and of moderate size (say four to six inches) is plentiful in the fields, and when it is difficult to advantageously procure good gravel, a foundation of stone may be interlaced between the bed of gravel and the prepared surface of the road. With light traffic this system gives good results, and will prove a good foundation for future macadam.

Qualities of Gravel

The gravel to be employed should not contain too large a proportion of sand, from 20 to 25 per cent. being sufficient. It should not be too earthy, and the small pebbles should be hard and of good quality. Some gravels contain a certain proportion of very soft pebbles, which crush under the wheels of vehicles. Such gravel should be completely rejected—it is not worth the transportation even for a short distance.

Certain gravels bind with difficulty—others more easily. Quartz gravel, from the bed of rivers, is very difficult to bind. However, some silicious gravel, coming from the banks outside of water-courses, bind well with time. When a hard gravel does not bind well a certain portion of clay or marl or limestone dust may be employed by incorporating it with the layer of gravel by the use of a harrow or by any other economical means.

The average distance that it pays to transport gravel depends upon its quality. First-quality gravel which makes a well resisting wearing surface is worth hauling three miles without too much loss. For poorer qualities this distance is much reduced. The cost of labor and of horses also has an influence on the minimum haul to be adopted.

Maintenance of Gravel Roads

The permanent part of gravel roads, that is to say, the ditches, the drains, the foundations, the slopes of fills and excavations, bridges and culverts should be maintained in the same manner for gravel roads as for other improved roads. The surface covering is kept in repair by the use of the split log drag, which should be used often, especially during the first year, to fill in the ruts, to level the surface, and to re-establish the crown. When the covering becomes too thin, and commences to break up from long usage, it is necessary to re-cover it with a sufficient layer of gravel to support the existing traffic without injury. Coverings constructed with hard gravel of good quality will last a long time without the addition of new material, but those which are constructed with sandy or earthy gravel wear more quickly and require more frequent additions.

Unscreened Gravel Roads

Roads with coverings of unscreened gravel are a special type. They must not be confounded with gravel or macadam coverings—that is, those made of screened gravel. They may be utilized in a large measure, and very economically, to improve earth roads, at the same time diminishing the cost of their maintenance. They are very suitable for local roads where the traffic is not very important. The maintenance of these coverings is very easy and inexpensive. It does not call for the use of costly machines or special labor, and the materials are usually close at hand. However, they support an active automobile traffic badly; they are generally dusty in dry weather; and if not looked after they are very muddy in wet weather. They are suitable only for local roads. In a general manner, however, these roads may play a very important part in the improvement of the roadways of the country.

Brick Pavements

By J. Duchastel

Mr. J. Duchastel, engineer of the city of Outremont, read a paper on "Brick Pavements." He said that the main principles governing the construction of a brick pavement were as follows: (1) the proper and efficient character of the sub-soil, most important in this climate; (2) the careful compacting of the sub-soil and the shaping of same to a grade to correspond with that of the finished pavement; (3) the construction of a proper concrete foundation, most necessary in cold climates and in localities where the drainage of the sub-soil was sluggish; (4) the adoption of a cushion layer between the concrete foundation and the bricks; (5) the careful laying of the bricks with the smoothest surface up and lugs laying in the same direction; (6) the thorough rolling of the ungrouted bricks to an even surface; (7) the thorough application of a proper cement filler; (8) the protection of the filler from rapid setting; (9) the prevention of traffic over the new pavement for a period of two to three weeks; (10) the competent supervision of the whole work by efficient men.

Mr. Duchastel then described the process by which a Dunn wire-cut-lug brick pavement was constructed on Laurier Avenue, Outremont, last year under his supervision, by day labor. The main advantage in using these bricks, he continued, was that the joints were all uniform in width on account of the presence of the lugs, which maintained the bricks at an equal distance from one another, and also the fact that the bricks had square corners, and that the joints could be filled from top to bottom at a uniform width without any danger to the grouting being chipped at the surface as in the case of bricks with chamfer corners.

It was well recognized that many failures in brick pavements could be traced to the non-uniformity of the sand cushion or the lack of proper compactness of same. It was claimed by some that a brick pavement should have a cushion so as to keep it resilient under heavy traffic. It was very doubtful to his mind if the sand contained between concrete foundations and the brick pavement had really any elasticity; his opinion was that the brick pavement itself might spring somewhat under the heavy traffic, but the sand cushion would not follow and small air spaces between the sand and the brick pavement might be formed, introducing weak spots which might cause serious trouble later. It had also been claimed that the sand cushion prevented the crushing of the brick pavement under heavy traffic; this idea, to his mind, was not well founded. If bricks well grouted were not able to sustain the load of modern pavement, the sooner they were discarded as paving materials, the better it would be.

The advantages now claimed in using a cement and brick bedding were as follows: elimination of the hazard of the sand cushion during construction, as the pavement would not be injured at any time by rain, the wearing surface, with the exception of the filler, being completed each day. If a rainstorm intervened no damage was done as there was no sand to become saturated and cause worry about rolling the brick surface. Each brick in the wearing surface would be assured a cement bond its entire depth, for if the cement sand should work in the joints, it would set up and prevent the shearing action which tended to crush the top of the brick. There was no chance for the bed to shrink or shift away from the bottom of the brick wearing surface, as the brick was firmly bedded in the cement sand or held in the mortar of the concrete base.

The advantages of brick roadways were as follows: when properly constructed with the right materials they wore smooth without being slippery; they were the most sanitary pavements known, being easily cleaned and absolutely dust proof; they were practically noiseless; they were economical in the long run as they required very little attention and maintenance; they could be cut through when required, and easily repaired at small cost without any cumbersome plant.

Mr. F. A. Snyder, chief engineer, town of Mount Royal, asked how contraction and expansion were cared for. In Philadelphia they put in cement grout expansion joints along the gutter of 1/4 in. to 1/2 in., then one through the centre, and also transversely for 25 feet. When not put in, there were cracks of about 25 feet blocks. Mr. Duchastel replied that they put in expansion joints, for the curb lines, 4 in. high by 1/2 in. thick; no transverse joints were used. He believed the concensus of opinion was that a transverse joint was the weakest part of a pavement, and it was hard to prevent bricks crumbling away at this joint. He thought that any variations of temperature would be disseminated right through.

Mr. Edwards, of Sherbrooke, enquired what was the reason why this particular class of brick was selected. Mr. Duchastel answered that the various points he had mentioned in his paper, together with the fact that no elaborate plant was required were the determining factors.

On the motion of Mr. J. Ballantyne, Mayor of Montreal West, seconded by Alderman Munro, of Outremont, a resolution was passed in favor of establishing national labor bureaus.

Highway Culverts in Quebec

By Alexander Fraser

A paper on "Highway Culverts," prepared by Mr. Alexander Fraser, Highways Department, Province of Quebec, was read. It stated in part:

The limits of application of the word culvert is not exactly established. In the following few words I will apply the word somewhat arbitrarily to all work of whatever type, from the circular culvert of 12 in. diameter, to the bridge or culvert of 8 ft. spans. In the province of Quebec these culverts are considered as an integral part of our roads and their permanent improvement is made in accordance with the plans and specifications furnished or approved by the Department of Roads. The construction of bridges of greater dimensions is generally carried out under the control of the Department of Public Works. But here again, naturally, when the question arises of making of a work of a permanent character on the probable line of a proposed provincial road, there is an understanding between the engineers of the two departments as to the location of the bridge in view of securing the best possible alignment. As the culverts constitute a permanent part of the improvement of our roads and their cost forms an important item in the total cost of that improvement, special attention to them is therefore necessary, together with method and economy.

On our provincial roads in the province of Quebec the average cost of the permanent culverts from 12 in. diameter to 8 feet span has varied from $800 to $1,500 per mile.

Circular Culverts.—In the province of Quebec we make circular culverts of 12 to 36 in. diameter on our provincial roads. All the circular culverts are of concrete and of all the other circular culverts made in the province a little more than two-thirds are of concrete, the rest being of corrugated steel, iron or vitrified clay pipe.

I believe that the concrete culverts will give the most satisfactory results if the materials used and the methods of construction are those commonly known as the best.

Concrete to-day, although it may still improve in the future, has passed the experimental stages as to the certain results expected. But our manufacturers of concrete pipes, at least as far as the province of Quebec is concerned, do not all use the best methods of manufacture. Fortunately, a movement is now under way with a view to the formation of an association of all the concrete pipe manufacturers like that existing in the United States, whose main purpose will unquestionably be to put on the market a more uniform product and of the very best quality.

The quality of the pipes is not, however, the only consideration that can assure to the culvert its permanency and its efficiency. It is also absolutely necessary that they are put in place with care if we want them to give good results. The need of intelligent and experienced foremen is greater than we are commonly let to believe, because it is often very expensive to repair a culvert when the roller has passed or the pavement is sometimes nearly finished, breaks or dislocations are noticed.

A culvert has two main purposes to perform—to provide a safe passage to the traffic and to secure a perfect drainage while protecting the road. To provide a safe passage to the traffic we will have to give the culvert a length equal to the width of the travelled way. This is specially important at the intersections of the roads. The addition of one or two pipes to a culvert in order to provide an adequate length can be done in most cases without increasing the cost of the culvert. The alignment of the culvert must be so as to provide a rapid flow of the waters. To that end the introduction of two or four right angles in the lines of a ditch for the laying out of a culvert, as it frequently happened in the old structure, must be avoided. If the line ditch at the upstream and downstream sides of the culvert happens to be on two different lines of not more than 25 feet apart we generally prefer to place the culvert at a certain angle with the centre line of the road, so that its two ends will meet the two lines of the line ditch at each side of the road.

We must specially care not to place the culvert at right angles or nearly so with the centre line of the road and between the two line ditches. If those two ditches were too far apart, it will be better then to place the culvert on the produced line of the upstream and ditch. By so doing we will get one of the two angles and we will reduce to the minimum the underminings which may be caused during the flooding season.

The trench to be excavated for the culvert ought to be at least two feet wider than the external diameter of the sheets to be laid. If the trench has but a width equal or nearly equal to the external diameter of the culvert it will be difficult to sufficiently ram the earth in the lower part, and the latter will seldom be rammed at all. Consequently, the culvert will not be held firmly in place, and when the rolling starts it will tend to move, and the joints will be dislocated.

Important Details

We must be careful to give the bottom of the trench a concave form suitable to the sheets to be placed so as to insure to the latter a greater bearing surface and of a more uniform resistance. The minimum grade of the bottom of the trench will have to be at least 5 in. per 100 ft., and be made so as, when the culvert is in place, to allow the water to flow freely on a regular grade inside as at the upstream and downstream ends. It is very important to have all the joints cemented on both sides, so as to avoid all washouts and caving in of the soil around the culvert.

A very important detail, which is too frequently put aside in practice, is to make the backfill by parallel and successive layers of not more than 6 inches thick and to perfectly ram each of them. The backfilling material must be carefully selected. It is necessary to pave the bottom of the ditch at the upstream and downstream end of each culvert, especially if, on account of a steep grade or of a break in the profile, there is danger of erosion occurring.

We must be careful to leave at least 12 inches of earth over the culvert, especially if we have to deal with vitrified clay, corrugated steel, or concrete pipe. If it is not possible to give the 12 inches, it will be better to lay a cast iron pipe culvert.

Other Descriptions of Culverts.—Most of the remarks made with regard to circular culverts apply to the other styles of culverts of plain or reinforced concrete, quadrangular culverts, slab culverts, with or without beams, and arch culverts. A control which cannot be exercised in the case of circular culverts, control of the mixture, of the quality of materials and of all the other details in the making of concrete, can here be exercised freely. To this end it is important to permanently keep a competent foreman or inspector on the work being carried out. His duty should not be limited to the supervision of the proportion of the mixture and the time of mixing each batch.

The width of the roadway on these culverts should be of 18 feet on local roads, and of 24 feet on trunk roads. The bed of the creek where the culvert is located must be paved with dry stone, if on account of the grade, it is exposed to erosion.

The alignment of the road in view of the location of these culverts must be made in a judicious way. Except where unavoidable, they should not be located on curves, especially on short radius curves. Too frequently culverts have been located to suit the creek, and not enough consideration has been given to provide a judicious alignment satisfactory to traffic.

Mr. A. E. Cunningham, representing the Lethbridge Board of Trade, alluded to the importance of highways to the country, which, he said, would be understood when it was remembered that practically every bushel of Western Canada's 300,000,000 bushel yield must now pass over some highway in its first stage of transportation.

The session concluded with an illustrated lecture by Mr. J. S. Crandell, of the Barrett Manufacturing Company, and formerly Professor of Highways at the Pennsylvania State College, on the Use of Refined Tar on Roads, both in penetration and treating systems.

Thursday, March 9

The opening paper of the first session on March 9, when Mr. B. Michaud presided, was by Major W. W. Crosby, C. E., consulting engineer, Baltimore. Prior to the reading of the paper, the chairman discussed at length the various types of roads in the province of Quebec, including natural, sand, gravel, macadam, concrete, and bituminous. He spoke of the advantages and disadvantages of the different types, their cost, and methods of construction. So far they had not found either in this country or in the United States a road which might be described as final in regard to perfection, but they were making progress along that line.

Mr. F. A. Snyder, referring to the dirt road, urged the importance of keeping the drainage ditches open. They ought to start work in the fall, and enable the water to run off quickly. Places where there were bad and spongy spots should be replaced with good hard material. He advocated the use of light instead of heavy machinery; the work would go further and the cost would be less. He would like to see the road drag more largely used, and had obtained very satisfactory results from a light road grader. The patrol system was to be preferred to the gang system. On no account should roads be allowed to deteriorate; engineers must keep up maintenance all the time.

Mr. C. D. French, of the Kinney Construction Company, referred to his experiences in constructing the Montreal-Quebec highway. Macadam, he said, cost practically the same as concrete, owing to the expense in the foundation of the sub-soil. Immediately after the building of a macadam road it was necessary to commence repairs, but this was not so in the case of concrete roads. After four months' wear of macadam roads, he found there were sags, and that, despite special precautions for the pipes and culverts, defects developed; in the concrete roads, however, there were no depressions whatever.

Road Drainage and Foundations

By Major W. W. Crosby

"Road Drainage and Foundations," was the subject of a paper by Major W. W. Crosby, consulting engineer, Baltimore. Drainage referred to is that provision made for taking care of water so as to improve the foundation of a road or protect it from injury. Foundations may be divided into two classes—natural and artificial. A natural foundation must ultimately be that portion of the earth's crust on which the beginning of the artificial structure rests. It may be some distance below the surface of the roadway, and be separated from the latter by various layers of construction, including an artificial foundation.

Requisites of a Good Foundation

The requirements for a good foundation are (a) that it shall be capable of supporting under the most adverse conditions likely to surround it the loads coming on it; (b) that it shall be homogeneous and uniform to an extent sufficient for the probabilities of the case; and (c) that the above qualities shall be obtainable at a minimum cost in the long run. There may be need, however, for considering the question of the probable permanence of the supporting power of the material under such conditions as may later arise. For instance, the incompressibility and supporting power of sand may be extremely high as long as there shall be no chance for the sand to flow. The tendency of the sand to flow may be tremendously increased by the presence of water. Precautions should be taken by provision for drainage to prevent the existence of such dangerous conditions. Drainage thus enters into consideration of the foundation, if for no other reason than to provide means that water shall not, by its advent into the foundation, injure the supporting power of the latter seriously. Drainage provisions should not be merely sufficient for the conditions existing at the time, but should be ample to take care of any conditions that may seem possible of occurrence.

Most natural materials can be made into sufficient foundations for pavements if they are of the so-called "mineral kingdom." The question, however, as to whether to use the natural mineral material in place, or whether to substitute something else for it, is often mainly an economic one. Modern tendencies are towards the more severe use of roads and streets, with greater demands on their foundations than heretofore, and these tendencies must be properly met.

Artificial Foundations

Artificial foundations include all layers of foreign material not naturally found in place, and specifically provided for the purpose of interposing a layer of some sort between the natural material and the pavement surfacing. Under this head will come sand, gravel or similar material, old or new macadam, old or new paving, as well as concrete slab. A layer of sand or gravel as an artificial foundation is used to good advantage on subgrades whose supporting power is relatively weak. Further advantages of such a layer are that it assists in providing drainage and in increasing the stability of the subgrade. Well-compacted macadam is high in its supporting powers and in its stability in place. The difficulty of using an old artificial foundation is to get it surfaced sufficiently even so that the final surface shall be smooth, and at the same time have the same degree of requisite uniformity and thickness.

Concrete Foundation

Apparently the highest type of artificial foundation is the concrete slab. The power of such a foundation to distribute widely stresses coming through it is very high. Little has been actually determined as to its distributing power and its ability in pavement foundations to carry indefinitely beamlike strains. Cement concrete slab, however, has proven its ability to aid weak subgrades to carry satisfactorily continuous heavy traffic. Too often the practice has been to consider no care necessary in the selection and preparation of the subgrade where a concrete slab was to be interposed between it and the pavement surface. The contrary should be the real practice.

The standard concrete foundation pavement in America is six inches in thickness, and a greater thickness has been advocated as desirable, and even necessary, under certain extreme traffic conditions.

Surfaces and Materials for Roads

By Col. Wm. D. Sohier

Col. William D. Sohier, Chairman of the Massachusetts Highway Commission, gave an interesting paper on "Selection of Surfaces and Materials for Roads as Governed by the Traffic that they must carry." Col. Sohier's paper included extensive statistics on traffic in different parts of the state, and the increased use of the motor vehicles.

The selection of the best materials and the proper use of those materials in the construction of a road surface that will remain in good condition for a reasonable length of time, and will economically carry the traffic that uses that particular road, is the most important as well as the most difficult problem which the highway engineer and road builder has to solve. Often, due to the lack of funds, he cannot build the class of road he wants to, or use the materials which he knows would give the best results. The engineer therefore has to take into consideration every time the money available, the best materials that can be secured within a reasonable distance of the road, and the best method of using these materials in constructing the road.

In the near future, no doubt, the heavy traffic of our roads will increase greatly, and will be carried by motor truck instead of wagon. Road builders must consider, therefore, not only the traffic that is now using any given road to be built or re-surfaced, or even maintained, but also what the traffic will be in the near future, and how much it will increase, and what changes will come in its character and volume. Col. Sohier dwelt at some length on the traffic census of roads in Massachusetts since 1909 up to the present, giving tabulation of the increases and changes in traffic in both motor and horse-drawn for the years 1909, 1912, and 1915; figures which are very interesting, and show conclusively that our highways must be strong enough to withstand heavy motor-truck traffic. He also dwelt with the pleasure traffic around Boston and metropolitan parks in the state. He also showed the increase in travel caused by building new good roads, quoting as illustrations the increased traffic on the Newburyport Turnpike, the Mohawk Trail, and other shorter popular pleasure drives about the state. Motors are always trying to find an easier route and to see a new country wherever the roads are fairly decent. When a really good road is built they come in hundreds and thousands, especially if the scenery is attractive.

Road Practice in Massachusetts

Dealing with the width of the road surface, Col. Sohier said that the standard practice for over fifteen years had been 15 ft. with a 3-ft. shoulder on each side, but with the increased motor traffic the present practice was 18 feet in width of hardened surface, with 21 feet width on all curves. Col. Sohier spoke of the present method used in road construction in Massachusetts, the selection of the type of road and the materials used, giving figures and statistics of their experience in road building in that state. Speaking of the growth of the better road sentiment in Massachusetts in the last eight years, he said that at present the Massachusetts Highway Commission is spending about three million dollars a year for construction and maintenance of State roads, while eight years ago they were only spending some $600,000 a year. In conclusion Col. Sohier pointed out that the best argument for a road is the road itself: "Get busy; build the best roads you can afford to build; locate well; secure sufficient width of location; drain it well, and grade it with proper materials; then keep the road constantly shaped and always in a passable condition. Show what a little care, attention, and money will do. One mile of good road in good order is a better argument for good roads, and will produce more votes and more money and more Good Road advocates in one year, than all the conventions and learned speeches that have ever been held and delivered in the last thirty years." In closing Col. Sohier mentioned the great pleasure it had been to him to attend the Conference and meet with the several engineers there—particularly Mr. McLean and Mr. Michaud, who are well-known in the States, and whose advice on questions affecting Good Roads is always valuable.

Mr. Snyder took up the question of road and foundations. In most cases, he said, it paid to put in side ditches to keep the water away from the roads. He advocated very strongly underdraining, this being an economical expenditure. In planning a new road, it was wise in the spring to carefully go over the route, which would minimize trouble when the work was commenced in the summer.

Mr. Paul Mercier, chief engineer of the city of Montreal, presented an illustrated paper, giving particulars of the civic departments, having special relation to the engineering, sewerage and road departments.

Concrete Roads and Pavements

By P. W. Wilson, M.A.S.C.E.

Mr. P. W. Wilson, M.A.S.C.E., consulting engineer of Philadelphia, read an interesting paper on "Concrete Roads and Pavements." The two most important items to be considered in road building are the selection of the type of road to build and the raising of the money to build such roads. In selecting the type the first cost of the road is a matter of consideration, and in many localities those having to do with the road construction have permitted their anxiety to stretch the amount of money available over as great a mileage as possible, and caused them to lose sight of the fact that the road was being built on borrowed money and that the time would come when the municipality would be forced to pay the money back.

The type of road should, therefore, be moderate in first cost—not necessarily cheap—and further, of the type of construction where the need of additional money accruing from taxes would not have to be expended in maintenance, but could be expended from year to year in extending the road system.

The present trouble seems to be to build too great a mileage of an inferior grade, rather than building less mileage of greater permanence, which would not require continuous repair. For those having nothing but dirt roads it seems a big jump to pass to hard-surfaced roads from a cost of practically nothing for the dirt road to a cost of about $10,000 per mile.

Items entering into the construction of the road are the consideration of cleanliness, non-slipperiness in wet weather, and dustlessness. These several conditions seem to be very well fulfilled in a concrete road.

The permanent character of concrete roads is best illustrated by the condition of the road after several years. They require an extremely low maintenance cost. Roads in use for over twenty years have been maintained for less than $30 per mile per year. In no case on record has the maintenance charge exceeded $50 per mile per year.

In building a concrete road great care should be taken to select the aggregates to secure the best results. Also, careful attention should be given to the question of drainage. The majority of the cracks in concrete roads are produced by the lack of proper drainage and the lack of proper preparation of the foundations, rather than from the effect of expansion and contraction. In selecting the materials the sand should be well graded in size from fine to coarse to give a minimum of voidage, and the coarse aggregates should be hard, durable, and clean, since they are depended upon to take the wear in any class of road construction. Bank-run materials should never be used without first separating by screening its coarse and fine aggregates so that the exact amount of each may be known.

In finishing the surface of a concrete road wooden floats are used to give a road a rough finish. As thin a coat of cement and sand as possible should be drawn to the surface, since this coat under traffic rapidly disappears, leaving the coarse aggregates to take the wear. The most common mistake in finishing a concrete road is in overfloating. Green concrete should not be exposed to the hot rays of the sun.

The time of opening a concrete road to traffic varies to a great extent with the time of the year the road is built. A road built in cold weather should be kept closed to traffic a much longer length of time than one built in warm weather.

The cracks which appear in a concrete road are due in almost every case to lack of drainage or the proper preparation of the sub-base. These cracks are, without doubt, unsightly, but they are not a serious detriment to the road provided they are properly cared for. The use of reinforcement is suggested as an insurance against poor drainage, and the lack of proper compacting of the foundations.

One of the most satisfactory tributes which can be paid to the concrete road is that where municipalities have one laid they continue to lay more of them.

Mr. W. A. Magor, in a brief paper, advocated the construction of a road from Montreal to Ste. Anne de Bellevue, giving a thoroughfare from one end of the Isle of Montreal to the other.

Winnipeg Next Year

The reading of three papers, the election of officers, and the selection of Winnipeg as the next meeting place of the Convention, comprised the proceedings at the concluding session on March 10. Mr. B. Michaud presided.

Roadways Legislation

After a paper by Dr. E. M. Desaulniers on "Legislation on Roads in Canada before Confederation," Mr. Arthur H. Blanchard, Professor in charge of graduate course in Highway Engineering, Columbia University, spoke on "Recent Developments in the Course of Construction of Bituminous Macadam and Bituminous Concrete Pavements." He dealt with the two types of bituminous pavements and gave details of construction and design. Three points were to be considered in connection with bituminous macadam pavements—the quality of broken stone to be used, the sizes of broken stone employed, and the character of the bituminous material used. The broken stone to be employed and the bituminous materials to be used were most important factors in the construction of bituminous concrete pavements or paving built by mixing methods. Professor Blanchard referred in detail to many classes of bituminous concrete and bituminous macadam pavements, and advocated the more general use of alternate specifications, instead of blanket specifications, in reference to various types of bituminous material. Under the former contractors had to bid on specific materials, instead of leaving it to them to adopt one of the many kinds of material on the market. By means of slides, Professor Blanchard gave many practical hints on the construction of bituminous roads. One slide showed a specification, in which there was a clause to the effect that the work should be carried out to the satisfaction of the engineers. This kind of specification, said the speaker, did not meet with his approval, although the particular job was carried out satisfactorily, owing to the broad-mindedness of the engineers and contractors. The matter of seal coat was of great importance, and under present conditions should always be used.

On behalf of contracting and supply firms, Mr. M. J. Stack, of Montreal, presented Mr. Michaud with a gold mounted cane, stating that the gift was an expression of their appreciation of Mr. Michaud's services. The President, in replying, stated that his work had been a pleasure, and he intended to do what he could for the progress of the good roads movement.

Creosoted Wood Blocks

Mr. A. F. Macallum, city engineer of Hamilton, read an interesting paper on the use of creosoted wood blocks in street pavements. Mr. Macallum has had a wide experience in wood block paving and is satisfied of their value. His experience is that where traffic has the choice between wood block and other pavements that the former is used to a much greater extent. The first cost of wood block pavement is higher than most other paving materials, averaging in the city of Hamilton from $2.85 to $3.00 per square yard, exclusive of grading. However, when its cheapness of maintenance, ease in cleaning, low tractive resistance and durability, are taken into consideration it will in general prove ultimately cheaper than a roadway of lower first cost. Mr. Macallum's paper will be treated more fully in a later issue.

Highway Bridges

"Highway Bridges," particularly those in the province of Ontario, were exhaustively discussed by Mr. Geo. Hogarth, chief engineer, Highways Department, Province of Ontario. Mr. Hogarth referred in detail to various types of bridges, from those in rural municipalities and sparsely populated districts to those in large cities. Methods of construction and material were enlarged on, and some defects in the old types pointed out.

Mr. J. Duchastel, President

This concluded the reading of papers, and the report of the nominating committee was then taken up. This report recommended the following names as officers for the ensuing year, the report being adopted: Hon. Presidents: Messrs. U. H. Dandurand, Montreal; W. A. McLean, Toronto; B. Michaud, Quebec; O. Hezzelwood, Toronto; President, J. Duchastel, city engineer, Outremont, P. Q.; vice-president, S. L. Squire, President Ontario Good Roads Association; secretary-treasurer, G. A. McNamee, Montreal; committee: Messrs. A. E. Cunningham, Lethbridge, Alta.; A. C. Emmett, Winnipeg; Howard Pillow, Montreal; J. A. Sanderson, Oxford Station, Ont.; R. S. Henderson, President Manitoba Good Roads Association; T. Adams, town planning expert, Ottawa; E. M. Desaulniers, M.L.A., Chambly County; J. W. Levesque, M.L.A., Laval County; Paul E. Mercier, chief engineer, city of Montreal; A. F. Macallum, city engineer, Hamilton; George Hogarth, chief engineer, Highways Department, Ontario Provincial Government.

On the motion of Mr. Emmett, representing the Manitoba Government, seconded by Mr. Cunningham, it was decided to hold the next convention in Winnipeg. The conventions have hitherto been held in the East, and the idea is to give them a wider scope, and to stimulate Western interest in the movement.

A vote of thanks to the retiring president, Mr. Michaud, concluded the proceedings.

Exhibition of Machinery and Road Supplies

As compared with the previous exhibition of machinery, road supplies, materials, etc., the one just concluded showed a considerable diminution in heavy machinery, but a more diversified number of road materials. The booths, including those of "The Contract Record and Engineering Review," and other trade papers, were tastefully decorated with red bunting, flags, and palms, and well furnished, and as the building was particularly well lighted, the effect was both business-like and artistic. Each booth was distinguished by a large card placed at the end.

Canada Cement Company, Montreal.—Almost the entire stage of the hall was occupied by the exhibit of this company, being the largest amount of space taken by any of the exhibitors. In the front of the stage was a large ornamental concrete fence made by Mr. De Grelle, of Montreal, and behind was a model concrete roadway, 30 feet long by 16 feet wide, showing the method of construction. The road was reinforced with the Kahn system of the Trussed Concrete Steel Company of Canada, Limited, and with Clinton fabric reinforcement manufactured by the Pedlar People, Limited. The Canada Cement Company had on view a number of pictures of concrete roads built through the Dominion.

The Pedlar People, Limited.—The exhibit of this company, occupying a portion of the stage, was a little out of the ordinary. One feature was, as above mentioned, Clinton fabric reinforcement in a roadway built by the Canada Cement Company. The Pedlar People had on show ferro dovetail plates for bridge floor reinforcement, rib fabric lath for reinforcing floor slabs, roofs, and partitions, and also Toncan metal culverts.

Paterson Manufacturing Company, Limited, Montreal.—In addition to many samples of Tarvia, this company showed a large number of illuminated pictures of roads in Quebec, Ontario and the United States treated with their well-known specialty.

Dunn Wire-Cut-Lug Brick Company, Conneaut, Ohio.—This firm have now 29 companies, operating 46 plants, under license manufacturing this class of brick. The brick is extensively used in Outremont, Lachine, Verdun, and Toronto. The exhibit consisted of wire-cut-lug bricks laid up, this brick being 4 inches in depth, 3½ inches in depth, and 3 inches in depth.

Asphalt and Supply Company, Limited, Montreal.—Quite a large show was made of this company's products. There were samples of Fluxphalte with views of the King Edward highway covered with this material, a job which will be finished this season. Besides Fluxphalte, there were samples of Eagle asphalt and asphaltic concrete, together with photos of Mexican oil wells, including the largest well in the world.

Canadian Fairbanks-Morse Company, Limited, Montreal.—In point of numbers, this company had the most extensive exhibition of machinery on view. Two machines were loaned to the company by the city of Outremont—a combined tank wagon and distributor, and a distributor, the latter being used for the penetration method on loose macadam roads. Three Wettlaufer mixers, a crusher, a kerosene road roller by the Ohio Tractor Company, a Star reversible traction wagon and a contractors' dump wagon (both by the Glen

Wagon Company), a Maney four-wheel scraper, horse scrapers and road ploughs, and a contractors' gasoline-driven pump, were also shown.

Canadian Tar Products Company, Limited, Montreal.—This concern is a comparatively new comer in the Canadian field. Its product is known as Tarmac, a preparation used as a binder for macadam roads and also for the re-surfacing of macadam roads. The company had also on exhibition paving pitch for block paving. The products are purely Canadian, and are manufactured from Canadian produced tar. The company is operating at Ville La Salle, near Montreal, a very complete tar distilling plant, one of the latest on the American continent.

The Philip Carey Company, Montreal.—At this booth there were samples of the Carey Elastite expansion joint—"The Sandwich joint"—which consists of a heavy body of special asphalt compound sandwiched between two layers of a special grade of asphalt-saturated wool felt,—the whole being firmly bonded together by a combining process of the company. The feature of this joint is the increased compressibility secured by increasing the volume of the asphalt compound, and keeping it in a solid body instead of distributing it throughout the joint in several thinner layers.

Imperial Oil Company, Limited, Montreal.—The products, as shown, were those which will be made in the new plant of the company now being constructed at Montreal East at a cost of a million and a quarter dollars. They will be manufactured from the finest Mexican oil which will be brought by tank steamers to the port. The exhibit consisted of asphalt for hot mix pavements—sheet asphalt and asphaltic concrete; asphalt binders, for the laying of penetration asphalt pavements; asphalt binders for re-surfacing macadam and gravel roads; light asphalts for re-surfacing and dust prevention on macadam and gravel roads; asphaltic liquids for dust prevention; and block filler for sectional pavements—wood block, brick and granite setts.

Creosoted Block Paving Company, Limited, Toronto.—Here were shown paving blocks, bridge floors, factory floors, and creosoted lumber. The company have a fine factory at Trenton, Ont., and their products cover a wide range in their particular field.

J. B. Dore and Fils, Laprairie, P.Q.—Road machinery is the specialty of this firm, who make road crushers, rock crushers, steam road rollers, road graders, portable and traction engines, scarifiers, etc. They had on show a "Little Ideal" road grader, which can be operated with two or four horses. They also had specimens of cast iron culvert pipe.

Elder Ebano Asphalt Company, Limited, Montreal.—At this stand there were samples of asphalt macadam, mastic asphalt for sidewalks, rock mastic asphalt, Paterson and Shawmut paving blocks, Norway pine creosoted blocks, and granite blocks—a very comprehensive exhibit.

Sawyer-Massey Company, Limited, Hamilton, Ont.—The company exhibited a steel reversible road grader of which there are over 2,000 in use in Canada; a portable rock steel frame crusher with folding elevator; and a double cylinder steam road roller with all-steel gears, differential gear, and renewable gear rims. The latter is, it is claimed, the only steam road roller built in Canada which is equipped in this manner.

The Montreal Concrete Works Company, Limited, Montreal.—The company showed numerous samples of their different styles and sizes of concrete pipe made at their plant at St. Francois de Sales, Que.

Canada Ingot Iron Culvert Company, Limited, Guelph, Ont.—Specimens of their rust-resisting "Armaco" culvert pipe in sizes 8 in. to 84 in., were shown. The company claim this pipe is particularly adapted for permanent highways as it will not break from traffic or frost.

Kinney Manufacturing Company, Boston and Montreal.—A combination power-operated kettle for bituminous materials was on view. It will heat for any temperature desired. The material is put on under pressure through a hand nozzle or spray pipes. The other exhibits were a horse-drawn distributor for light oiling or dust laying, and a portable loading outfit from tank cars to distributors. In Canada the company is represented by Mussens, Limited, Montreal.

Quinlan & Robertson, Limited, Montreal.—This firm of contractors had on view a large number of photos, showing progress of various road, conduit, canal, railway, etc., contracts carried out in all parts of the Dominion.

Rigaud Granite Company, Limited, Montreal.—Exhibit demonstrated methods of constructing "Durax" pavement; samples of "Durax" paving, which is "Made in Canada," were also shown. It is claimed that this type of pavement is used extensively in the United States and Europe.

Aztec Oil and Asphalt Refining Company of Canada, Montreal.—A display was made of samples of Aztec liquid asphalt, road binder, and refined asphalt. These are natural asphalt products, and are made from Mexican raw material.

J. H. McCarty & Company, Montreal, and Rene Talbot, Quebec.—A working model of a Champion crusher, made by the Dominion Road Machinery Company, Limited, Goderich, Ont., was shown in this booth, together with a gasoline fire engine manufactured by the Waterous Engine Works Company, Limited, Brantford, Ont. Besides these, there were photographs of a complete line of road making machinery, street cleaning machinery, and fire apparatus.

Comet Motor Company, Limited, Montreal.—Exhibited a New Packard worm driven truck and a Chalmers "30."

T. A. Morrison & Company, Montreal.—Exhibit showed samples of "Tamco" Banc Rouge Trap for macadam roads; also samples of river sand and Milton pressed brick.

Stack and Leger, Montreal.—Photos of various road and paving contracts carried out.

G. Aybram, St. Emile Junction, P.Q.—Exhibition consisted of samples of Silex gravel sands.

Kennedy Construction Company, Limited, Montreal.—Various photos of concrete roads built by the firm in the vicinity of Montreal were on view.

Trussed Concrete Steel Company of Canada, Limited, Walkerville, Ont.—Featured Kahn road mesh, Kahn armor plates and Kahn curb bars. It is claimed for the Kahn road mesh that it is extremely rigid, easily placed and will stay where placed without being staked. Kahn armor plate is used in protecting edges of contraction joints, and as it is made of dead soft steel it wears down with the road. Kahn curb bar is used to protect the wearing edges of concrete curbs.

The Province of Ontario loaned a number of models showing the construction and materials of various types of roads, while the city of Montreal displayed a number of plans and also loaned some road machinery.

Methods and Costs of Garbage Disposal

Different Systems of Final Disposal Employed by U. S. Cities — Incineration and Reduction — By-Products — Methods of Financing Cost

THE State Bureau of Municipal Information of the New York State Conference of Mayors and other city officials—W. P. Capes, director —have recently issued their report No. 52 on "Methods and Costs of Collecting and Disposing of Garbage in Cities." This report describes the different systems of collection and disposal now used by the larger cities in America, points out the factors which affect the cost, and gives the opinion of experts for and against the various systems. All the information has been recently collected and published as a guide for those cities desiring either to establish systems or to improve existing ones. The following extracts covering the disposal of garbage are taken from the report:—

The methods that may be adopted by a city for the disposal of its garbage are as follows:—feeding to swine, dumping on land, dumping into large volumes of water, disposal by sanitary fill, burial, incineration, and reduction.

In selecting its disposal system a city should at the same time consider its collection system. Some cities collect and dispose of their garbage by contract, others collect by contract and dispose of it themselves, or vice versa, and still others have all the work done by city employees.

Feeding to Swine

Most of the smaller cities in this country dispose of a part or all of their garbage by feeding to swine. The others either collect their garbage by contract and sell it or give it to farmers or those operating piggeries, or maintain a municipal collection and sell to a contractor who maintains a piggery. The necessity for sterilizing the garbage before it is fed to hogs is disputed.

Kansas City, Providence, Denver, and other cities have their garbage fed to hogs, with the uniform result that the cost of removal is reduced to some extent to the city and that the contractor, according to his business capacity, is able to make more or less profit from the feed so obtained. There is no danger in this system under proper handling. Any danger to the hogs can be prevented by prompt handling of the garbage to prevent unnecessary fermentation, and by the use of hog cholera serum to prevent disease. The proper cleaning of the pens, if in the city, eliminates any danger to man. There should be some method of sorting the garbage before feeding it to pigs so that the stale garbage may be discarded and buried or burned. Some places disinfect it by boiling in large cauldrons before feeding. In such cases the cooked garbage is commonly used only as a base for the feed given to the pigs. The method is a most profitable one and warrants consideration in small cities where isolated farm sites are available.

Dumping on Land

It is the concensus of opinion in all reports and of all experts that this method is objectionable, especially where there is a large quantity to be disposed of. A long haul is necessitated by the location of the dumps at a remote distance, where the decomposition of any part of the refuse will not be offensive to neighboring property owners. When the garbage is deposited in sufficient quantity offensive odors due to fermentation may create a nuisance. Unless special attention is given to the treatment of these dumps, the method will not be found desirable. A thorough mixing of garbage with ashes and rubbish will prevent the nuisance and the fires that are otherwise liable to occur, creating odors and nuisance from the smoke and unconsumed gases. This method is one that cannot be defended either from an aesthetic or sanitary standpoint. The dumps become an ideal breeding place for flies.

Dumping in Large Bodies of Water

Only a few cities use this method. In most places where it has been tried, it has been prohibited because the material is washed on the neighboring shores.

Disposal by Sanitary Fill

This method is practised by some cities, among them Seattle, Davenport, and New Orleans, which report its success. It is being given more serious consideration than heretofore by several large cities. The method is different than that of burial, in that it is carried on by filling excavations, vacant low lying ground and natural ravines.

The garbage, rubbish and ashes are dumped and then mixed with sufficient earth to insure oxidation and thorough digestion of the decomposing wastes. The activity of the bacteria of the soil breaks down and mineralizes the organic matter and when there is sufficient oxygen, i.e., air, no putrefaction or other odors result. Success depends upon the following treatment:

(1) The garbage must not be buried so deep that bacteria activity is reduced.

(2) The garbage must not be spread in a thick layer on the surface of the ground.

(3) The ground must be sufficiently open and drained so that air can penetrate to a sufficient depth.

(4) The garbage must not overload the soil, but must be sufficiently diluted with earth, ashes and rubbish, so that putrefaction may take place, due to the presence of an ample supply of air in the pores of the soil.

This method has been demonstrated to be not only sanitary, free from nuisance when properly carried out, but economical as well. The Health Commissioner of Seattle describes their system and results as follows:

"This method of filling works very satisfactorily in this climate, but I believe it necessary to include all waste materials, as ashes, boxes, tin cans, etc. These all assist oxygenation and nitrification. I do not believe pure garbage can be handled in this way.

"We also find that it is best to keep as little of the face of the fill exposed as possible. It is always best to keep a man constantly on the job, whose duty is to rake down to the bottom of the fill all boxes, rough materials, etc., thus leaving the ashes to form a covering on top. When this is not sufficient, we cover with a layer of earth about five inches thick.

"The success lies in the proper mixture of waste materials, and next the fill must be properly covered to protect from flies. Chemicals can also be used to protect same. This covering also prevents the slight sour odor of fresh garbage and by keeping out the sunlight, at the same time encourages bacterial growth by increasing the warmth inside of the fill. People residing within one hundred feet of these fills make no complaint, but the public has to be educated when you first adopt this method. We aim to fill city property, as ravines, swampy lands or docks on the lake or salt water front.

"Our laboratory findings show that the process is simply one of slow incineration by nature, instead of the expensive method of burning by incinerators, and at the same time help prove that there is nothing detrimental to public health in these fills.

"We have eleven fills distributed over our city, thus making short hauls, and these are taken care of by eleven laborers, disposing of approximately three hundred and fifty tons per day by this method alone, while one incinerator with about an equal pay-roll will only dispose of sixty to seventy-five tons per day, running twenty-four hours. A fill increases the value of property, while the refuse from our incinerator has to be hauled away at an added cost."

The Health Commissioner in 1913 reported that after spreading, there was applied an antiseptic spray of crude carbolic acid, rosin and caustic soda to kill eggs and larvia of flies, mosquitoes and other insects that might breed.

Burial

Garbage may be buried either by putting it in shallow trenches and covering with the excavation from the trenches for the next day's deposit, or by ploughing under. It digests and is thoroughly taken up or oxidized by the action of the soil.

A summary of the opinions indicates that disposal by burying when properly conducted and when the point of disposal is suitably located gives no cause for objection from a sanitary standpoint. The principal objections are the extremely long haul, the amount of land necessary and no direct income. In small communities this method is entirely satisfactory. It is usually not applicable to large communities.

Disposal Plants

There are two methods of disposing of garbage in plants; incineration and destruction. There is a wide diversity of opinion among experts and city officials as to which is the better from a sanitary and financial standpoint. There is, however, nearly universal opinion upon the following:

1. That the revenue from the by-products of municipally owned and operated plants will not pay the combined cost of collection and disposal.

2. That with only a few exceptions, the revenue from the by-products of municipally owned plants pays the cost of disposal.

3. That the price received by cities from contractors is, with a very few exceptions, not sufficient to pay the cost of collection.

4. That the disposal of garbage by the reduction process is uneconomical for a city with a population of less than 100,000. Some experts increase the size to 150,000 and one to 200,000.

5. That incineration is better than reduction for a city with a population less than 100,000.

In the report of the Chicago Waste Commission, some general rules are laid down for the design of a disposal works, irrespective of method. It says that the design should permit the plant to be operated as a whole, or in part, so that each part can be operated as an independent unit. This will permit one or more parts to receive attention and be repaired during the season when the minimum quantity of refuse is to be disposed of. The details of the plant should be such as to permit cleanliness at all times and hosing and washing so as not to permit garbage dust or dirt to accumulate, flies to breed and material to decompose. All material, so far as possible, should be enclosed during the process of disposal and the odors eliminated or confined and deoderized. The handling of material in the plants, so far as possible, should be eliminated, where mechanical means can economically be adopted. Special attention should be paid to ventilation and the elimination of dust where men are required to work.

The odors or nuisances caused from disposal plants will usually arise from one or more of the following sources: Garbage or refuse, incomplete combustion or combustion temperatures not sufficient to eliminate odors, congestion of carts in one locality and creation of dust. The odors arising from raw garbage which are found in all plants are mostly local and will not create a nuisance a short distance from the point of handling and the housing of equipment used in hauling.

Incineration

Two kinds of plants are used for this method of disposal,—crematories and destructors. Many destructors are in operation in America, but of the crematories which have been built, many have been abandoned. Heat for destruction must be obtained not only from the garbage itself, but also from ashes and other combustible waste. It is here that the difference between destructors and crematories enters. In the former, heat is obtained from the refuse itself; in the latter, garbage is burned at the expense of coal, wood or oil. It seems to be the prevailing opinion that in order to make incineration a success the material must be burned at a high temperature and rapid rate of combustion.

Morse claims that destructors require twenty per cent. less area of ground, cost fifteen per cent. more for boiler and machinery; that the construction is more durable; no addition of fuel; that the gases of combustion are consumed, and that this method has by-products of clinker and power and destroys all combustible refuse, and that the net cost of operation is less per ton.

Crematories, he says, require more ground and more time for disposal, but cost less. They are less durable, require addition of fuel, gases are incompletely destroyed, cannot develop power, the residue has no value and they can burn only garbage and rubbish. The gross cost of operation is a trifle less, but the net cost is more.

Tests of garbage crematories in Ohio, according to the State Board of Health, show that "the plants as operated fail usually to dispose of the garbage at a temperature high enough to avoid the production of odors." This, says J. T. Featherston, is significant and conclusive.

Regarding mixed refuse destruction, Featherston says: "Three features may be noted: No added fuel is required, steam power is produced and quite a residue (clinker) results. Compared with tests of garbage crematories the average destructor temperatures in connection with the gas analyses indicate freedom from odor due to unconsumed gas. Thus the mixed refuse type of plant corrects the inherent defects of the garbage crematory."

Cost of Incineration

The cost of incineration plants depends upon the garbage to be handled. The various incinerator companies usually estimate the capacity of the plant at about one ton per 1,000 population.

Reports show that disposal by incineration in Ohio is confined to cities of from 20,000 to 80,000 population, and that its success has been confined to the very large and to the rather small cities of the country. Some assert that it is applicable in the very large cities only when the collection systems are suitable to provide for the burning of mixed refuse. In small cities it is the custom to cremate the garbage alone, the other classes of waste being dumped or buried.

The cost of construction, reports show, ranges from $600 to $1,000 per ton capacity. The Worcester Special Waste Commission says that "from a calculation based on some thirty incinerators it has been found that the cost per ton daily capacity varies from $250 to $1,000, the average being between $600 and $700."

The by-products are clinker and the steam generated.

Robert W. Wylde says that the cost of operating destructors "is in a great measure offset and frequently quite overbalanced by the revenue" from the sale of steam and clinker. One hundred tons of refuse burned during 16 hours a day produces 800 engine h.p. Clinker from 100 tons might amount to 30 tons per day and would bring $1.00 a ton in many localities. Another expert says that one pound of refuse has been found to produce ½ to 1¾ pounds of steam. The value of refuse as a fuel is estimated by one expert to be 40 cents per ton.

The Chicago Waste Commission report points out, "that experience in connection with the development of power from refuse furnaces demonstrates that it is not easy to find an available use whereby the power developed can be utilized regularly as produced and the furnace operated continuously. In the majority of plants constructed, it has not been possible to utilize all the power available, and in most cases the use is limited to the operation of the plant. When power developed is used in lighting and power stations, the demand only comes during a part of the day. Supplementary coal-fired boilers are usually found in connection with destructor-electric lighting stations, or else the destructor is much larger than would be required to deal with the refuse alone. The power produced from refuse furnaces will best be utilized by some local industry, such as ice-making plants or electro-chemical plants, which require continuous operation. When power is used in connection with pumping plants, it is found good practice to operate the refuse plant only as an auxiliary to the power plant of the pumping station. The saving that results or credit that can be given the destructor plant will amount to the value of the fuel equal to that which it requires to produce the amount of steam developed and used. The fluctuating amount of power developed in most cases can be depended upon only for the average minimum production. In selecting a site for the location of a refuse disposal plant from which power is developed it is not always profitable to utilize the power where the demand is not constant and where the demand would be constant, suitable sites are not always available."

Venable says that if a city has a steam power plant, it will pay, but it will not pay to build one for that purpose.

In a suburb of Montreal, the refuse destructor is constructed in connection with a municipal electric light power station and power is used in generating electricity for lighting purposes. The plant is operated only during the time when lighting load is in demand, and the material as delivered is stored during the day and burned at night. Only a part of the power is furnished by the refuse furnaces, the remainder being obtained from a coal-fired boiler plant.

In Savannah, Ga., the waterworks boilers are kept in service, with banked fires, to use in case of shortage of garbage.

(Concluded in next Issue)

Personal

Mr. George Herrick Duggan, recently elected president of the Canadian Society of Civil Engineers, has had a wide experience as an engineer. He is a native of Toronto, born in 1862. He was educated at Upper Canada College, and at the School of Practical Science,

Courtesy International Press

Mr. G. H. Duggan.

University of Toronto, taking a post graduate course in 1884-86. Mr. Duggan joined the engineering department of the C. P. R. in 1886. From 1891 to 1901 he was chief engineer of the Dominion Bridge Company. Later he was appointed assistant to the president and consulting engineer of the Dominion Steel Company and Dominion Coal Company, and from 1904 to 1910 was second vice-president and general manager of the latter company. In 1910 Mr. Duggan was appointed vice-president and general manager of the Dominion Bridge Company, a position he still holds. He is also chief engineer of the St. Lawrence Bridge Company, the contractors for the steel work of the Quebec bridge; vice-president of the Montreal Ammunition Company; and director of the Montreal Trust Company. He joined the Canadian Society of Civil Engineers in 1888, became a member in 1890, and was for ten years a member of the Council. In 1906 he was vice-president of the Canadian Mining Institution, being on the Council of the same society during 1911-13. He is also a member of the Institution of Civil Engineers, England, and of the American Society of Civil Engineers.

Mr. Duggan takes a great interest in sport, particularly in yachting, and is a member of several yacht clubs; he has designed and sailed winning yachts in the Seawanhaka International Cup races. In 1893 Mr. Duggan was awarded the Royal Humane Society's bronze medal and certificate. In October last Mr. Duggan lost one of his two sons, H. S. Duggan, R. E., who was killed in action.

Colonel Stewart, of the 86th Machine Gun Battalion, now on active service, is the senior member of Stewart & Witton, the well-known architects of the city of Hamilton.

George T. Evans, architect, Hamilton, has received a commission in the C. A. S. C., and will go to Quebec shortly to qualify.

New Monitor Transit

The C. L. Berger & Sons, manufacturers of surveying, engineering, and astronomical instruments, 37 Williams Street, Boston, have developed a new type of transit and level known as the "Monitor," which is claimed to be a distinct improvement both in design and construction of field instruments. These new instruments include several new features, the most striking of which are the exceptionally rugged, strong, and rigid standards. The manufacturers also claim the following characteristic features for these instruments: outer forms rounded, of greater stiffness, and water-shedding; tripod heads of rigid construction; centres long and stout; non-cramping levelling head; unyielding and quick-acting clamps; improved vernier arrangement; water-tight compass box; simplified combination of needle lifter with arrangement for instantaneously setting against declination east or west; telescope standards and vernier plates of great lateral stability; eye piece cap of large diameter; arrangement of centering instrument from point above; levelling instruments set low on tripod; protection to spirit level and slides; and so on.

Montreal Wages Schedule

At a joint meeting of the Builders' Exchange and the Building Trades' Council held in Montreal recently the following schedule of rates was suggested to the Board of Control for the year 1916: Stone masons, 40c.; bricklayers, 45c.; structural iron workers, 30c.; ornamental iron workers, 27½c.; plasterers, 40c.; lathers—metal, 40c.; lathers—wood, 35c.; hoisting engineers, 35c.; tile setters, 45c.; plumbers, 40c.; steam fitters, 40c.; steam fitters' helpers, 25c.; carpenters, 35c.; stone cutters, 45c.; marble cutters, 40c.; marble setters, 40c.; painters, 30c.; sheet metal workers, 35c.; roofers, 35c.; electrical workers, 35c.; cement finishers, 40c.; elevator constructors, 35c.; laborers—common, 20c.; laborers—hod carriers, 22½c.

Steel Bridge over Sauvage River, P. Q.

The general contract for the construction of a bridge over the Sauvage River at Lambton, County Frontenac, P. Q., has been let to Messrs. Galbraith & Cate, Limited, Montreal, the steel being supplied by the Dominion Bridge Company. Tenders sent in were for a wooden bridge and a steel bridge, and the Quebec Streams Commission, for whom the work will be done, decided on a steel structure, which will replace the present one. The new bridge will have three spans of 180 feet each, supported on two concrete piers and two abutments resting on solid rock. The piers will be 52 feet high from rock bottom, or 31 feet above low water. The bridge will contain 200 tons of steel, Warren truss spans being adopted, designed to specifications of the Public Works Department. The contract price of the work is $46,734. Mr. O. Lefebvre is the chief engineer of the Commission.

In order to take care of its rapidly increasing business, the Osgood Company, of Marion, Ohio, manufacturers of steam shovels and dredges, has found it necessary to double its capacity and has purchased the manufacturing plant of the Ohio Tractor Company. The larger machine tools, for which crane service is desirable, will be moved to the main plant of the Osgood Company, while the smaller tools and the foundry will be operated at their present location. The Ohio Tractor Company has acquired a new site in the south part of Marion, and is making arrangements to increase its output.

Only one company, the National Brick Company, of Laprairie, Limited, tendered for the supply of three million bricks required by the city of Montreal. The price was $8.25 per 1,000 f.o.b. cars or $9.50 delivered on the job. The Controllers accepted the latter bid.

The London Concrete Machinery Company have secured the contract to furnish the Chatham Cement Tile Company with one 10 cu. ft. batch mixer to be used in their tile plant at Chatham.

New Books

Elevators—by John H. Jallings; American Technical Society, Chicago, publishers. This is a practical treatise on the development and design of hand, belt, steam, hydraulic and electric elevators, written by an author who has had nearly fifty years of actual experience in elevator building and who has been a witness of all the wonderful changes that have taken place during this time, as well as a contributor to the development of many of them. The book is divided into three sections; part one deals with hand-power elevators, belt-power elevators and worm and gear; part two deals with steam elevators, and hydraulic elevators; part three, motor elevators. As the available literature on elevator construction and design is very meagre it is believed that this volume will find a popular place in the elevator field and satisfy a real demand. 217 pages; well illustrated; size 8½ x 5½; bound in red cloth.

Building Blocks—booklet issued by the Cast Stone Block and Machine Company, Limited, Windsor, Ont., describing the cast stone system of manufacturing granite veneered cement building blocks. The booklet is well illustrated throughout with various types of block and machinery manufactured by this company.

Mainly Constructional

The London Concrete Machinery Company, of London, Ont., have secured the contract to furnish six ½-yard batch mixers to be shipped to Les Fils de Jules Weitz, of Lyons, France.

The Doty Engine Company, Limited, of Toronto, has been incorporated with a capitalization of $100,000. The company will carry on a general mechanical engineering business.

The value of the building permits issued by the city of London in February was $18,765, as compared with $13,500 for the same month of 1915. The total for January and February was $37,995—nearly $13,000 more than for the same period of 1915.

Lieut. George T. Evans, architect, Hamilton, Ont., has gone to Quebec to qualify for his commission in the Army Service Corps. Lieut. Evans is a graduate of the University of Pennsylvania, and a member of the Ontario Association of Architects. He has been practising his profession for about two years.

What is said to be the first highway for the exclusive use of automobiles ever built was finished recently between Tampico and Panuco, Mexico, a distance of about thirty-five miles. The highway was constructed by the oil companies, and is for the use of motor trucks and automobiles in extensive oil operations at Panuco.

It is announced that the National Construction Company, Limited, the contractors for the new Law Courts Building at Winnipeg, have made an assignment, and are found to have a deficit of approximately $101,000. A committee of creditors, assisted by Mr. C. H. Newton, official assignee, are investigating the company's affairs.

A Winnipeg company has been formed to open a granite quarry in the district east of Winnipeg traversed by the Greater Winnipeg Water District Railway. Former Controller McArthur and A. L. McIntyre, a stone worker, are interested in the enterprise. It is said that the granite in the deposit is equal to that now being imported from Eastern Canada.

Former members of the city of Vancouver's engineering staff who have joined the Empire's military forces since the war began are: Private B. E. Spencer, 1st Australian Brigade; Lieut. P. O. Spicer, Royal Engineers; Sergt. W. W. Sayer, Canadian Engineers (died at Comox); Private W. L. Railton, 67th Battalion; Private H. Whillier, 72nd Highlanders, and Private M. Stanbridge, 72nd Highlanders.

Members of the Legislature paid a visit to the limestone quarries and stone-cutting plant of the Wallace Sandstone Quarries, Limited, near Tyndall, on February 24. From these quarries comes the well-known Tyndall stone, which is being used in the construction of the new Parliament Buildings, Winnipeg. The party, which was composed of thirty members of the legislature, several Winnipeg architects, and two professors of the University, were conducted over the plant by Messrs. Peter Lyall and A. U. Cote, respectively director and manager of the Wallace Sandstone Quarries, Limited.

The city of Quebec issued thirty-six building permits, of a value of $57,020, during the month of February. This is an increase over the same month of last year of $2,722. There is a large increase for the first two months of 1916 over the corresponding period of 1915. Last year from January 1st to March 1st there were 79 permits issued for the sum of $82,203, while from January 1st to March 1st of the present year 62 permits have been given out to the sum of $118,565. While the number of permits are fewer this year so far, the value of the work being done is considerably in excess of that of last year.

A detailed description of the Government's great floating drydock at Prince Rupert was given on March 2 by Mr Pillsbury, of the engineering staff of the Grand Trunk Railway, and engineer in charge of the construction of the northern dock, before the members of the Vancouver Branch of the Canadian Society of Civil Engineers. The dock has a lifting capacity of 20,000 tons—about the tonnage of a steamer of 650 feet. It is in three sections, each one capable of being sunk and lifted independently for the accommodation of smaller vessels. In connection with it there is a very complete plant, including light and power plant, machine shop, and shipbuilding plant. The cost of the whole plant, dock and all, had been $2,600,000, but the cost of the dock and its accessories was about $800,000.

An interesting departure from the ordinary methods of home-building is being introduced into Quebec by Mr. V. R. Lamontagne, real estate broker and architectural builder. Mr. Lamontagne has bought outright, at a low figure, a block of city land, which he has divided into lots forty feet wide. Special arrangements have been made with regard to building material whereby a substantial reduction in price can be offered. In order to facilitate the building up of this district, Mr. Lamontagne is prepared to asist his clients in every possible way, and to this end has secured the services of an experienced architectural designer and construction expert. Artistic appearance is to be combined with economical construction, and the purchaser of a lot and house has at his disposal the best advice as to design and arrangement of his home, and obtains all the most modern conveniences, every need being supplied from one source at moderate prices.

The municipal officials of Ladner, B. C., are considering the advisability of inaugurating a new style of road construction in the Delta. Recently a representative of the Columbia Bitulithic Paving Company, of Vancouver, made a proposition to the council for the laying of a blanket paving on a mile of road as an experiment. The roadway which it is proposed to treat with this material, if a decision is arrived at, is the main highway for one mile from Garvey Road to Benson Road. Some of the councillors are of the opinion that under present conditions the expense would be too heavy.

The efforts of the Toronto-Hamilton Highway Commission to secure a number of special privileges for the new inter-city highway, as embodied in their bill which will be presented to the Legislature at this session, are not acceptable to the members of the York County Council. At a meeting of the Legislative Committee, held on March 3, in the County Municipal offices, Toronto, the members, after a lengthy discussion, decided to strenuously oppose the granting of any special legislation to the Toronto-Hamilton Commission.

The Montreal papers state that the city of Montreal is saddled with three million brick that they do not want. A requisition for bricks came in from the Sewer Department, on the representation that there were none on hand. The Board of Control called for tenders, and on March 3 last gave an order for three million brick to the National Brick Company. Later it was discovered that there was an uncompleted order for two million brick, of which a million were available for immediate delivery. To complicate matters further, at a meeting of the Board of Control held on March 6, Controller Giroux presented a letter from the L'Islet Brick Company, which declared that company's willingness to furnish the city with brick at lower prices than any other firm was charging. The letter was dated February 26, and stamped "received" that date. Mr. Giroux wanted to know why it had been held back until the brick contract has been awarded. The Mayor demanded an investigation. Failing to find the culprit, the Board took the next move, and asked the Law Department to see if there was any way of cancelling the big contract, or of reducing it.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Aylmer, Que.
The Town Council have been ordered by the Provincial Board of Health to construct a filtration plant. Estimated cost, $20,000. Clerk, A. Malherbe.

Bienville, Que.
The Municipality have had plans prepared for the construction of water and drainage systems on Wolfe Street, estimated to cost $4,000. Engineer. C. Lessard, City Engineer, Levis.

Hull, Que.
The City Council have been instructed by the Provincial Board of Health to instal a mechanical filtration plant, estimated to cost $200,000. Engineer, J. P. A. Laforest.

Lethbridge, Alta.
Work will start shortly on the construction of a sewer to connect the Duff addition sewers with the disposal plant. Estimated cost, $7,500. Engineer, W. S. Harvey.

London, Ont.
The City Council propose to spend $4,000 on the construction of sanitary and storm sewers on Grand Avenue, and also to lay a sanitary sewer on Inkerman Street. Engineer, H. A. Brazier.

Orillia, Ont.
The Town Council are considering the installation of new machinery at the sewage pumping station. Engineer, W. K. Greenwood.

Rougemont Village, Que.
The Municipal Council intend to construct cement sidewalks, estimated to cost $8,000. Secretary, A. Ledoux.

CONTRACTS AWARDED

Elmira, Ont.
The Town Council have let the contract for extensions to the waterworks system to A. M. Bauman, Floradale Street. Contractor is now receiving prices on iron and lead piping, brass fittings and pig lead.

Ottawa, Ont.
The City Council have let the following contracts for waterworks construction:—buildings, Doran & Devlin, 104 Sparks Street, $54,000; pipes and specials, Victoria Foundry Company, 44 Booth Street, $9,233; valves, General Supply Company, 356 Sparks Street, $7,666; plumbing and heating, A. Guthier & Company, 247 Dalhousie Street, $3,375.

The contract for the supply of pipe for the sewer to be constructed on Lyon Street has been awarded to T. Sidney Kirby Company, Ottawa.

Railroads, Bridges and Wharves

Agincourt, Ont.
The Canadian Pacific Railway have agreed to construct a bridge, estimated to cost $15,000, and the Village Council will arrange for new roads. The matter has been submitted to the Dominion Railway Board.

Dunville, Ont.
The Grand Trunk Railway Company propose to construct a siding in the spring. Superintendent, W. R. Davidson, London.

Edmonton, Alta.
The Canadian Northern Railway Company intend to complete the St. Paul de Matis line by the end of June. Particulars from J. McLeod or G. Brown, McLeod Block, Edmonton.

Lacombe, Alta.
An effort is now being made to have the Blind Man Electric Railway completed. Particulars from W. Puffer, M. P. P., Lacombe.

London, Ont.
The London Street Railway contemplate double-tracking on Dundas Street E. previous to the laying of the asphalt pavement. Manager, C. B. King.

Port Hope, Ont.
Plans of a bridge to be constructed over the River at Peter Street have been prepared by Bowman & Connor, 31 Queen Street W., Toronto, for the Town Council. Tenders will be called shortly.

Victoria, B. C.
The City Council have made satisfactory arrangements with the Railway Companies and the Government with regard to the proposed Johnson Street bridge and will submit a by-law shortly. Clerk, W. J. Dowler.

Wainfleet, Ont.
The Grand Trunk Railway Company, Montreal, propose to construct a passenger siding in the spring. Superintendent, W. R. Davidson, London.

CONTRACTS AWARDED

Renfrew County, Ont.
The County Council have awarded the contract for the construction of a bridge over Indian River to J. M. Kennedy, R. R. No. 7, Pembroke. Approximate cost, $4,000.

Public Buildings, Churches and Schools

Elmvale, Ont.
Tenders on the erection of a school for the Trustees of School Section No. 5, Flos, will be received until March 31st by the Secretary, W. J. McGuire, Elmvale. Architect, John Wilson, Collingwood. Estimated cost, $21,000.

Hamilton, Ont.
The Board of Education will receive tenders until 4 p.m., March 20th, for the erection of an addition at the Robert Land School. Architect, J. G. Hutton, Bank of Hamilton Building. Estimated cost, $30,000.

Low Point, N. S.
Work may start in the spring on the rebuilding of the Roman Catholic church. Concrete construction may be used. Pastor, Rev. Father McAulay.

Mission, B. C.
The Municipality propose to build a school at an approximate cost of $3,000. Secretary, J. A. Lampard, Mission.

Mt. Dennis, Ont.
Tenders will be received until March 20th for the erection of a school for the Trustees of School Section No. 28. Architects, S. B. Coon & Son, Ryrie Building, Toronto. Estimated cost, $25,000. Brick construction.

Orillia, Ont.
A by-law will be submitted to the ratepayers on March 29th to authorize the raising of $35,000 for the erection of a Municipal Building. Town Clerk, C. E. Grant.

Portage La Prairie, Man.
Tenders on the erection of a school will be called shortly. Estimated cost, $78,500. Architect, F. R. Evans, 130 Selkirk Avenue, Winnipeg.

Quebec, Que.
The Department of Public Work, Ottawa, have had plans prepared for an addition to the Post Office, estimated to cost $100,000. Architect, J. P. Ouellet, 28 St. Famille Street.

The Roman Catholic School Board are having plans prepared for a school to be erected on St. Luc Street. Estimated cost, $10,000. Architects, Tanguay & Lebon, 20 d'Aguillon Street.

Rimbey, Alta.
The erection of a school is being considered. Secretary to the School District, William Saunders, Rimbey.

St. Antoine De Bienville, Que.
Tenders on interior work at the Parish Church will be called about 1st April. Architect, P. Levesque, 115 St. John Street, Quebe.

St. Edouard De Frampton, Que.
Plans for an addition to the convent are being prepared by P. Levesque, 115 St. John Street, Quebec.

St. Jean De Dieu, Que.
Tenders will be called about 1st April for the erection of a church. Estimated cost, $60,000. Architect, P. Levesque, 115 St. John Street, Quebec.

Ste. Peppetue, Que.
Sketch plans of an addition to the Parish Church are being prepared by P. Levesque, 115 St. John Street, Quebec.

Toronto, Ont.
P. H. Finney, 79 Adelaide Street E.,

has prepared plans for a lodge hall for the East Toronto Lodge No. 263, I. O. O. F. Estimated cost, $4,000. Frame and brick construction.

The Dickie Construction Company, Ryrie Building, are receiving sub-tenders on trades required in the erection of a Home at Brockville, school at Elmvale and a club building on University Avenue, Toronto.

The Separate School Board have had new plans prepared for the proposed school in St. Monica's Parish. Architect, C. J. Read, 203 Confederation Life Building. Estimated cost, $25,000.

Plans have been prepared by C. J. Read, 203 Confederation Life Building, for an addition to St. Peter's School for the Separate School Board. Estimated cost, $10,000. Tenders will be called shortly.

West Vancouver, B. C.
The Municipality propose to erect a school at an approximate cost of $4,000. Secretary, J. S. Yates, Hollyburn, B. C.

CONTRACTS AWARDED

Saltfleet Township, Ont.
The Burlington Beach Commission have let the contract for the erection of a frame school to Coates & Son, Burlington.

St. Antoine de Pontbriand, Que.
The School Board have let the contract for the erection of a school to L. Pomerleau, Jr., St. Antoine de Pontbriand.

West Flamboro Township, Ont.
The general contract for the erection of a school in Union School Section No. 3 has been let to M. H. Hewitt, Dundas, Ont. Contractor is receiving quotations in lumber.

Business Buildings and Industrial Plants

Aylmer, Que.
W. E. Noffke, Plaza Building, Rideau Street, Ottawa, is preparing plans of a toll house for the Aylmer Road Company. Concrete and brick construction.

Bathurst, N. B.
W. C. Barnes, Wyse Building, Moncton, is preparing plans for rebuilding the store of William J. Kent & Company, Ltd. Brick construction.

Berlin, Ont.
The Regal Auto Company propose to build a factory. Manager, R. Nyberg. is preparing plans for a large barn. Frame construction.

Coatsworth, Ont.
Levi Coatsworth is considering the erection of a store.

Cobden, Ont.
J. McDermott, Main Street, is rebuilding his stores, recently destroyed by fire. Frame construction.

Dalhousie, N. B.
The erection of a store is being considered by William Hyman & Son. Estimated cost, $5,000. Architect, P. B. Troy.

Fenelon Falls, Ont.
James Fraser intends to build three stores to replace those destroyed by fire. Cement block construction.

Hamilton, Ont.
The E. T. Wright Company, Cathcart Street, propose to erect an addition to their factory and also contemplate the erection of an office on Wellington Street.

Levis, Que.
A number of changes have been made in the plans of the proposed station for the Intercolonial Railway Company, and the contract will not be let until the summer. Architects, Ross & McDonald, 1 Belmont Street, Montreal.

London, Ont.
Watt & Blackwell, Bank of Toronto Building, are preparing plans for an arena to be erected on Richmond Street N. at an approximate cost of $50,000. Reinforced concrete construction.

The Grand Trunk Railway Company propose to build coal chutes, estimated to cost $25,000. Steel and concrete construction. Particulars from John E. Dalrymple, Head Offices of the Company, Montreal.

McBride & Gilbert, Edge Block, are preparing plans of a club house to be built on St. George Street for C. S. Hyman & Company. Estimated cost, $10,000. Construction, reinforced concrete, hollow tile and brick.

The International Harvester Company have had plans prepared for a warehouse to be built on York Street, at an approximate cost of $75,000. Work may proceed this year. Manager, S. McConvrey.

Loretteville, Que.
F. Renaud contemplates the erection of a store. An existing building on the site will be demolished.

Merlin, Ont.
Z. Sales will have plans prepared at once for a blacksmith shop and carriage factory, estimated to cost $3,500.

Montreal, Que.
Plans have been prepared for a bank and residence to be erected at Mt. Royal and Delorimier Streets for the Banque d'Hochelaga, St. James Street. Architect, L. A. Amos, 78 Crescent Street. Estimated cost, $4,000.

Nootka, B. C.
W. R. Lord, Tenth Street W., Vancouver, proposes to build a cannery.

Ottawa, Ont.
The projected addition to a warehouse on Slater Street for the Henry Bate Realty Company will be erected by day labor. Concrete block construction. Estimated cost, $8,000. Architect, W. E. Noffke, Plaza Building, Rideau Street.

James and Frank Wilson, 8 Allan Place, have commenced the erection of stores and a residence, estimated to cost $6,000. Prices are being received on the smaller trades.

Port Arthur, Ont.
Work hs been started on the erection of an addition to an elevator for Davidson & Smith Elevator Company under the supervision of D. F. Fegles, c/o Barnett & McQueen, Christina Street, Fort William. Estimated cost, $250,000.

Prince Albert, Sask.
The Codville Company, Ltd., First and 24th Streets, Saskatoon, are considering the erection of a large store. Manager, K. Sinclair.

Quebec, Que.
The St. Lawrence Paper Bag Company, 103 Marguerite Street, contemplate the erection of stores, estimated to cost $6,000. Architect, J. P. Ouellet, 28 St. Famille Street.

Ruthven, Ont.
Holly Fox contemplates the erection of a garage and will have plans prepared.

Shawenegan Falls, Que.
The Canada Carbide Company, Ltd., propose to construction an addition to their plant in order to double the capacity.

Sparta, Ont.
Work is about to start on the erection of two dairy barns for John Rundle, Sparta Road, under the supervision of Charles Cloes. Frame construction. Estimated cost, $7,000.

Tilbury, Ont.
Bedard Bros. have purchased a site for a store and will have plans prepared. White brick construction. Estimated cost, $5,000.

Toronto, Ont.
Plans have been prepared for a stable and wagon house to be erected at the Island Incinerator for the Board of Control.

Plans will be prepared by P. H. Finney 79 Adelaide Street E., for three stores and apartments to be built on Danforth Avenue by G. N. Ferrier, 302 Danforth Avenue. Estimated cost, $10,000. Brick construction.

Maurice Thaler, 350 College Street, will probably be in the market shortly for seats, generators and machines for a picture theatre.

The current estimates of the Property Department include $14,000 for an addition to the Civic Abattoir, including two boilers.

A. W. Wolfe, 163 Adelaide Street W., proposes to build a warehouse at Spadina Avenue and Wellington Street, estimated to cost $50,000. Brick and mill construction.

Tenders will be called shortly for additions to the premises of L. Yolles, 379 Queen Street W. Architect, H. S. Kaplan, 75 Macdonell Avenue. Brick construction.

B. Brown, 217 Queen Street W., is receiving tenders on the erection of an addition to a store for Charles Lauder Company, 99 Ontario Street. Brick construction.

Turin, Ont.
Peter McAlpine proposes to erect a barn in the spring.

Wingham, Ont.
C. E. Lepard will call for tenders about the 1st April for remodelling the hotel. Work will include cement walls and roofing, and is estimated to cost $4,000.

A. M. Crawford will receive tenders until March 27th for the erection of a garage and sales room, estimated to cost between $5,000 and $7,000. Architect, D. C. Smith.

Winnipeg, Man.
P. M. Clemens, 498 Maryland Street, is preparing plans for a hall and office building to be erected for the Royal Templars Hall Company. Estimated cost $10,000.

CONTRACTS AWARDED

Aylmer Que.
The general contract for the erection of a garage and alterations to a residence for A. Fournier, 323 Wellington Street

has been awarded to E. Wentzleff, 249 McKay Street, Ottawa. Brick and concrete construction. Approximate cost, $6,000.

Brantford, Ont.
Work will start shortly on the erection of a storage building for the American Radiator Company, Ltd., South Market Street. The greater part of the work has been let to P. H. Secord & Sons, Ltd., 133 Nelson Street. Estimated cost, $10,000. Brick and mill construction.

Chatham, Ont.
The contract for plumbing in connection with the stores which are being built for Fred Bates, William Street, has been awarded to Robert Mitchell, Fourth Street.

Copper Cliff, Ont.
The Canadian Copper Company, Copper Cliff, have let the general contract for the construction of a store and a large number of lodging houses to J. B. Laberge & Son, Sudbury. Work has been started.

Lindsay, Ont.
F. R. Wilford & Company, Ltd., have prepared plans for an addition to their factory on Kent Street and have let the general contract to Reese Williams, William Street. Brick construction.

Montreal, Que.
L. Lebel, Sault au Recollect, has commenced the erection of a residence and store for L. D. Gagnon, 6490 Lajeunesse Street. Estimated cost, $5,500. Brick construction.

The general contract for the erection of a store and residence for Pierre Ducharme, 6404 Lajeunesse Street, has been awarded to L. Lebel, Sault au Recollect. Brick construction. Approximate cost, $5,000.

In connection with the construction of a steam plant for the Montreal Tramways Company, 78 Craig Street W., the contract for steel has been awarded to the Dominion Bridge Company, Ltd., Lachine.

Ottawa, Ont.
Bonnell Bros., Slater Street, have let the general contract for alteration to their store front to R. E. McKinstrey, 91 Second Avenue.

The general contract for alterations to a store for Robert Kennedy, 221 Sparks Street, has been awarded to P. J. Ellement, 624 Cooper Street. Estimated cost, $4,000.

The following contracts have been let for alterations to a store for The Two Macs, Ltd., Bank and Sparks Streets:—carpentry, Garnet Douglas, 382 Waverley Street; copper front and lead work, McFarlane & Douglas, 250 Slater Street; glass work, Colonial Art Glass Company, 840 Bank Street; metal ceilings, R. J. Cameron, 488 Lewis Street.

Peterborough, Ont.
The general contract for the erection of an addition to the factory of the Bonner-Worth Company has been awarded to William Langford, Water Street. Estimated cost, $8,000. Brick and mill construction.

In connection with the addition to the premises of the Auburn Woollen Mills, River Road, the contract for the installation of a high pressure steam heating system has been let to R. G. Sturgeon & Company, Charlotte Street.

Toronto, Ont.
The proposed bank at Vaughan Road and St. Clair Avenue for the Canadian Bank of Commerce will be built by the Dominion Realty Company, 34 King Street W., who are also preparing the plans. Estimated cost, $20,000. Steel and brick construction.

Westboro, Ont.
J. Hamilton has commenced the erection of a store and residence on Richmond Road, and has let the masonry to Beattie & Davidson, Renfrew Avenue, Ottawa. Estimated cost, $4,000. Brick veneer construction.

Windsor, Ont.
The contract for roofing required in connection with the plant which is being constructed for the Curtis Company, Chatham Street W., has been let to Welsh Bros., 40 Sandwich Street W.

Winnipeg, Man.
The general contract for the erection of a warehouse at Hargrave Street and Graham Avenue for the T. Eaton Company has been let to Carter-Halls-Aldinger Company, 1010 Union Bank Building. Estimated cost, $300,000.

Residences

Aylmer, Ont.
Clarence M. Smith, c|o Milan Powers, proposes to build a number of residences on Spruce and John Streets this summer, and will prepare plans.

Charlottetown, P. E. I.
Chappell & Hunter, Des Brisay Block, are preparing plans for a residence to be built on North River Road for A. E. Duff, Great George Street. Estimated cost, $9,000. Frame construction.

Chatham, Ont .
Work will commence very shortly on the rebuilding of the residences of Abram and John Turner. Particulars from Harvey Armstrong, Sixth Street.

Dalhousie, N. B.
Earl Annett proposes to erect a bungalow this summer and has had plans prepared by P. B. Troy.

P. B. Troy has prepared plans of a residence for Mrs. Troy. Estimated cost, $5,000.

Hamilton, Ont.
J. A. Armes, Federal Life Building, is preparing plans for a residence to be erected for T. S. Orr, Main Street. Estimated cost, $12,000.

Kingston, Ont.
William Newlands & Son, 258 Bagot Street, are preparing plans of an apartment house for James Elder, 207 William Street.

Kingsville, Ont.
W. T. Conklin proposes to alter a residence into a two storey bungalow.

London, Ont.
J. F. Orme, 175 James Street, has plans prepared for a number of residences to be built on Hydro Street, at an estimated cost of $10,000, and is also considering the erection of several residences in the North End of the City.

Loretteville, Que.
The erection of a residence on Hamel Street is contemplated by J. Linteau.

Montreal, Que.
A. Goudreau, 155 Joliette Street, has commenced the erection of four flats on Chambly Street, estimated to cost $3,000. Brick construction.

Ottawa, Ont.
Donald L. Campbell, 6 Driveway West, has prepared plans of a residence, estimated to cost $6,000. Stucco and double brick veneer construction.

Parry Sound, Ont.
George White, Bowes Street, proposes to build four residences in the spring. Frame construction.

Peterborough, Ont.
William Blackwell, Water Street, is preparing plans for a residence to be built at 454 Weller Street for Dyson Worth, 476 Cedar Street. Estimated cost, $5,000. Brick construction.

Port Credit, Ont.
W. G. Hunt, 17 Queen Street E., Toronto, is preparing plans of a residence. and will call for tenders very shortly.

Quebec, Que.
Work has been started on the erection of an addition to a residence at Durocher and Ste. Therese Streets for P. D. St. Michel, 29 Sous le Fort Street. Frame and brick construction. Approximate cost, $3,000.

Riverside, N. B.
Leonard Heans, 84 Germain Street, is preparing plans of a residence for R. W. Roach, c|o Brock & Patterson, King Street, St. John. Estimated cost, $5,000. Concrete block construction.

Rougemont Village, Que.
J. B. Blanchard proposes to build a residence, at an approximate cost of $3,000.

A residence will be erected by D. Malo, at a napproximate cost of $4,000.

Sarnia, Ont.
R. W. Fawcett, 152 Essex Street, is preparing plans for a residence for John Dawson, Postmaster. Estimated cost, $3,400.

St. John, N. B.
E. J. Fleetwood, 111 Carmerthen Street, contempltes the erection of a residence, estimated to cost $4,000. Plans will probably be drawn by F. Neil Brodie, 42 Princess Street. Brick construction.

Toronto, Ont.
Plans have been drawn for a pair of residences to be erected on Donlands Avenue by L. H. Lankin, 124 Hampton Avenue. Estimated cost, $3,000. Roughcast and brick construction.

Tenders are now being received on all trades except painting required in alterations and additions to a residence for Mrs. S. Davies, 560 Spadina Avenue.

J. H. Bone, 18 Toronto Street, is receiving tenders on the erection of a residence, estimated to cost $5,000. Architect, W. G. Hunt, 17 Queen Street E. Tapestry brick construction.

Walkerville, Ont.
Plans of a residence to be built on Kildare Road for F. E. Allum, Detroit, Mich., are being prepared by Williams Bros., Detroit. Stucco construction.

Westboro, Ont.
A Cather, Royal Avenue, is building a residence, estimated to cost $3,000. Brick veneer construction.

Whitby, Ont.
Plans will be prepared by P. H. Finney, 79 Adelaide Street E., Toronto, for a residence to be built for R. Thompson, Whitby. Estimated cost, $5,000. Brick construction.

Tenders will be received until March 22nd for the erection of a residence for Robert Hutchison, Public School Inspector. Architects, Barber & Tilley, Temple Building, Brantford. Estimated cost $6,000.

Winnipeg, Man.
William Bruce, 1280 Wolseley Avenue, has prepared plans for a residence to be built for David Wark & Son., 709 Merchants Bank Building. Estimated cost, $6,000.

CONTRACTS AWARDED

Brantford, Ont.
The general contract for the erection of a residence for L. D. Chapin, 37 Wellington Street, has been awarded to Nathaniel Kew, 97 Erie Avenue, and the heating and plumbing to R. H. Ballantyne, 347 King Street. Approximate cost, $8,300.

London, Ont.
A contract has been let to J. F. Orme, 175 St. James Street, for the erection of a residence on Oxford Street, estimated to cost $5,000. Red pressed brick construction.

Niagara Falls, Ont.
The general contract for the erection of a residence for Mrs. C. W. Brown, 218 Bridge Street, has been awarded to Field Bros., 80 Third Street. Brick construction.

Ottawa, Ont.
Leon Petregorsky, 87 Goulbourne Avenue, has commenced the erection of apartments at Laurier and King Streets, and has let the roofing to John Carnochan, 151 Fifth Avenue, and the heating and plumbing to Coldrey & Chapman, 330 Rideau Street.

Quebec, Que.
E. Bertrand, 288 Third Avenue, Limoilou, has commenced the erection of a residence, estimated to cost $5,000, and has let the contract for masonry to J. B. Verret & Son, Limoilou. Brick construction.

Strathroy, Ont.
The general contract for the erection of a residence for J. R. Alexander has been let to W. Hartford. Estimated cost $8,000. Architects, Watt & Blackwell, Bank of Toronto Building, London.

Toronto, Ont.
The Board of Control have awarded contracts for the installation of sanitary conveniences in a number of residences to F. R. Maxwell, 367 Queen Street W., and to Sheppard & Abbott, 78 Harbord Street.

Westboro, Ont.
J. Hamilton has commenced the erection of a residence, and has let the masonry to Beattie & Davidson, Renfrew Avenue, Ottawa. Estimated cost, $3,800. Brick veneer construction.

Power Plants, Electricity and Telephones

Alvinston, Ont.
The Town Council are considering the installation of a hydro electric system. Clerk, John Irving.

Bedford Mills, Ont.
The Bedford Mills Electric Company, Newboro, Ont., contemplate the installation of a 60-k.w. dynamo, connected to water wheel, with transformers and all other equipment. Estimated cost, $6,000. Manager, R. P. Tett.

Calgary, Alta.
The City Council have let the contract for the supply of switch board equipment to the Canadian Westinghouse Company, Hamilton, Ont., at $9,773.

Mt. Forest, Ont.
The Mt. Forest, Wellington & Grey Telephone Company propose to extend their lines to Gleneden from Pike Lake. Manager, J. Corly, Mt. Forest.

South Woodslee, Ont.
The Rochester Telephone Company intend to construct a line between Pleasant Park and Belle River. Secretary, Oscar Ray, c/o the Company, Belle River, Ont.

St. Thomas, Ont.
The City Council intend to secure estimates on transformers. Clerk, W. B. Doherty.

Fires

Ashburn, Ont.
Residence, owned by F. Vareoe, completely destroyed.

Beauport, Que.
Residence of Jean Baptiste Giroux totally destroyed.

Cobden, Ont.
Residence of D. Tuffy, Main Street. Loss $3,500. Previously reported under Ottawa.

Fairbank, Ont.
Residence of Thomas Whitehead, 11 Stratton Avenue. Loss, $3,000.

Ford, Ont.
Boarding house owned by Samuel Tisner. Loss, about $5,000.

Fort William, Ont.
Elevator of the Grain Growers Grain Company, Hardisty Street, completely destroyed. Loss, $60,000.

Galt, Ont.
Imperial Hotel, owned by J. A. Macdonald, damaged to extent of about $35,000.

Goderich, Ont.
Planing mill of the Buchanan Planing Mills Company. Damage estimated at $6,000.

Hamilton, Ont.
Stores on St. James Street N., owned by T. H. Gould. Loss, $3,000.

Markham, Ont.
Agricultural buildings at Fair Grounds and Skating Rink completely destroyed. Loss, about $15,000.

Melita, Man.
Canadian Pacific Railway Company's station completely destroyed.

Moose Jaw, Sask.
Packing plant of the Gordon Ironside & Fares Company, Ltd., Lillooet Street W. Loss, $50,000.

Ottawa, Ont.
Planing mill owned by Mde. Charpentier, 141 Main Street, Ottawa East. Damage, $3,000.

Oxford, N. S.
Business block, owned by J. R. Gilroy, totally destroyed.

Quyon, Que.
Hotel owned by J. Lavalette and residences of W. McLean and Arthur Reeder. Total loss about $10,000.

Renforth, N.B.
Residence of James Griffiths, c/o Manchester Robertson Allison Ltd., King Street, St. John, N. B. Loss, $5,000.

Renfrew, Ont.
Still house and machinery owned by O'Briens Ltd., completely destroyed.

Rodney, Ont.
Residence of Benjamin Miller totally destroyed. Owner is considering rebuilding.

St. Camille, Que.
Sawmill, owned by Gaudias Maurice. Loss, $3,000.

St. John, N.B.
Warehouse of Dearborn & Company, Ltd. Loss, about $35,000.

Trenton, Ont.
Garage owned by Graydon & Clegg. Estimated loss, $10,000.

Welland, Ont.
Furniture factory of the Jeffries Furniture Company completely destroyed. Loss, $4,800. Company will rebuild as soon as possible.

Westmount, Que.
Stables, owned by D. Harrison, Prince Albert Street. Loss, $5,000. Owner will rebuild.

Miscellaneous

Burlington, Ont.
The Town Council will shortly submit a by-law to authorize the expenditure of $3,500 on fire equipment. Clerk, James S. Allen.

Calgary, Alta.
Fire Chief Smart has recommended the purchase of 5,000 feet of fire hose immediately. City Clerk, J. M. Miller.

Lethbridge, Alta.
The City Council propose to purchase a motor-driven pump for pressure-raising purposes. Estimated cost, $4,000. Clerk, W. A. Stevens.

Listowel, Ont.
Nathan Calder proposes to instal equipment at his planing mill, to be operated by hydro power.

London, Ont.
The Department of Militia & Defence propose to enlarge the rifle ranges in the spring, at an approximate cost of $10,000. Timber and steel construction.

Ottawa, Ont.
The Board of Control will receive tenders until March 28th on the supply of two motor-driven flushers. Specifications at office of the Engineer, F. C. Askwith.

Toronto, Ont.
The Board of Control will receive tenders until March 26th for the supply of treated wood blocks and crushed

stone. Specifications at Room 12, City Hall.

Victoria, B. C.

J. E. Griffith, Deputy Minister of Public Works, Victoria, will receive tenders until noon, March 21st, on the supply of 675 school desks. Specifications at the Department.

Windsor, Ont.

A by-law has been carried authorizing the purchase of a tractor and two service trucks for the Fire Department. Estimated cost, $15,000. City Clerk, S. Lusted.

CONTRACTS AWARDED

Montreal, Que.

The City Council have awarded a contract for the supply of about 3,000,000 brick for sewer work to the National Brick Company of Laprairie, Victoria Square, Montreal.

Peterborough, Ont.

The contract for supply of cement has been awarded by the City Council to the Peterborough Hardware Company, George Street, and for sewer pipe to R. Hicks & Company, Murray Street.

Pointe Aux Trembles, Que.

The Imperial Oil Company have let a contract for the supply of about 3,000,000 brick to the National Brick Company of Laprairie, Victoria Square, Montreal.

Subsurface Land Slip Causes Building Collapse at Baltimore

A subsurface earth movement in connection with nearby dredging brought about the settlement of a large area of ground and the collapse of a stock shed of the American Agricultural Chemical Company in the Canton pier district, Baltimore. Dredging was in progress at the time in preparation for the erection of a new coal pier for the Pennsylvania Railroad.

The stock shed faces on Clinton Street, and runs back about 300 ft. to a bulkhead near the pier head line of the harbor. It is one of a group of light timber sheds, consisting of a series of open bays with about 30 ft. between rows of timber columns, which rest on concrete pedestals. The shed floor is paved with a bituminous concrete.

The level of the shed floor was about 11 ft. above mean tide. On the side where the settlement occurred, there was originally a plot of open land, several hundred feet wide, and extending from the bulkhead to the street; that is, covering the inshore end of the new coal pier site. The specifications required that the site be excavated to a 35-ft. depth in the slip at the side of the pier, it being planned to leave the excavated bank on a slope of about 1½ to 1 without bulkheading, since adjacent cuts in the local strata of sandy clay, hard sand and iron stood almost vertically, and other slopes within 500 ft. had stood up for years. The shoulder of the slope was fixed about 15 ft. outside the line of the chemical stock shed, which brought its toe about 75 ft. away.

The dredges had been working in the pier slip prior to the settlement, principallly beyond the toe of the slope, but, shortly beforehand, one of them had been trimming the slope at a depth of aout 16 feet. About three or four weeks before the collapse of the building a crack was noticed in the floor of the shed. No special significance was attached to this, since it was from 30 to 60 ft. back from the shoulder line of the dredging and nearly 300 ft. from the harbor bulkhead. The crack widened somewhat as the work progressed, and some settlement occurred. Several shed columns were shimmed up, but it was taken to e only a small local settlement which could be adjusted after the dredging was completed.

On February 2 an area of the shed flood, 60 ft. wide by about 200 ft. long, dropped to a maximum depth of 8 ft., taking the building with it. The greater depth was on a sheer perpendicular cleavage along the line most remote from the water. The slope was thence upward to the original ground level near the outer line of the shed. A tonnage of land at original level, tapering from 15 ft. wide at its inshore end to nothing at its outshore end, remained undisturbed between the sunken area and the pier site, leaving the shoulder of the excavation practically intact for a distance of about 50 ft. from the harbor bulkhead, where it had also sunk under water. The sunken area was then landlocked for a distance of 150 ft. There was apparently a movement from beneath the area of the shed diagonally out toward the harbor. It is thought this was due to the gradual bleeding of a large pocket of sand, though most of the material taken out by the dredges had been noted to be clayey, with no undue amount of loose sand.

The situation will be met by driving sheet piling along the inland line of the break to check any further tendency toward movement, then bulkheading the slip after dredging, and finally filling back of the bulkhead.

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Principal Contents

Tenders Without Competition

THE town of Drummondville, P. Q., is asking for tenders on a gravity filtration plant. This in itself would scarcely call for editorial comment if the method of procedure were along usual lines, but the fact is that tenders are being called —competitive tenders—on specifications prepared by a firm of consulting engineers, that are worded so deliberately that competition in certain parts of the work is entirely eliminated. So much so that these specifications definitely state the manufacturer from whom the various equipments must be purchased—the pumps must be so-and-so's make, the gas engine so-and-so, the motors so-and-so. This holds throughout the entire list. They even go so far as to give the name of the sub-contractor who must supply and install certain of the equipment. Indeed, the only thing that seems to have been omitted in these specifications is the name of the general contractor who will be awarded the contract for which so-called tenders are now being asked —doubtless merely an oversight.

It is scarcely possible, we believe, to condemn in too strong terms such a pernicious and unbusinesslike way of conducting municipal matters. It must be condemned on four counts at least. (1) there is no assurance that the most suitable equipment for the purpose, considering operating conditions, manufacturers' guarantees, price, etc., is being installed; (2) there is a possibility, to put it mildly, that the price paid for this equipment, purchased under compulsion, a fact known to the manufacturer, will be unduly high; (3) there is the unfairness to competitors of good standing in the field who have earned the right to be heard; and (4) there is the almost certain result of doing public business in other than an entirely open and aboveboard way—that there will be charges and suspicions of graft.

* * *

To the first it may perhaps be answered that the best in each case has been selected. With all due consideration for the names mentioned in this particular case, we do not think this argument can reasonably be advanced in the present highly developed state of our commercial life. To-day it is not a matter of choosing the best, but rather a question of choosing from among the best. And this condition, it is only fair to recognize, has been brought about, more than through any other agency, by competition. As a matter of recognized fact, the conditions surrounding counts 1 and 2, that is, both high quality and reasonable price, are directly due to the very principle of competition that this municipality is so deliberately ignoring.

For this reason too, if for no other, competitors have a just right to be heard in favor of the particular equipment they manufacture and sell. Manufacturers and salesmen must to-day be recognized as specialists, each in his own particular line. The history of the past few years has taught us that merit more often than not is democratic, and may be found as intimately associated with some of our younger industries as with those of time honored names. But this can, in general, only be learned through investigation and demonstration and it is for this purpose chiefly that salesman specialists are employed—to demonstrate the merits of their goods. It follows then that these men must be heard before the merits of their goods can be properly appreciated.

On the fourth count, public opinion, there is perhaps little that can be said that is not mere repetition. Honest men and crooks look alike from the outside and apparently about the only way the public have of defending themselves from dishonest officialdom is to suspect everybody. The onus of proof thus rests with the officials and in consequence the wiser course is surely to so conduct public business that the light of day has free access to every item. The people pay the bills. Is it not their right to know how and why the money is spent?

* * *

The only reasonable course for Drummondville, or any other municipality, to pursue in such a case is to get away, as far as possible, from this idea of doing things in an arbitrary way. To-day we are fighting for freedom, at home and abroad—freedom of thought, freedom of action, freedom from dictation by any individual or group of individuals who would force their opinions upon us. It is the basis of our national strength—the right of men to be heard—the right of every individual to be given a chance to convert others to his way of thinking. The Drummondville council will be well advised to reconsider their present course and to start all over again, call for tenders for equipment in the usual way and give everybody a fair chance. The rights of the citizens of Drummondville demand this, and, no less, the rights of those men whose competition is responsible for the present favorable conditions of quality and price surrounding, in general, machinery equipment on the Canadian market.

Disposal of Garbage

DIFFERENT systems of collecting and disposing of garbage, and the factors which affect their cost, form the basis of an extensive investigation and a subsequent report just to hand by the State Bureau of Municipal Information in the New York State conference of mayors and city officials. This report, extracts from which appear in this issue, has been prepared as a guide for cities desiring either to establish garbage systems or improve existing ones.

The garbage problem falls naturally into two divisions—collection and disposal. Treating these separately, collection may be either combined or separate, or some combination of the two—for instance, separate collection of garbage and combined collection of ashes and rubbish. Reports agree that if all wastes are collected together the cost of collection will be less than if collected separately. The method of collection may be either by licensed cartmen, those served paying the expense; by contract, where the city pays a fixed sum annually to some contractor; or by the municipal system, where the city does the work. Experts are agreed that the last named system is the best. Service is rendered as desired, the system is under better control, is carried on with better equipment and is generally much cheaper to the tax-payer.

The kind of equipment, location of receptacles, and frequency of collection are big factors which vitally affect the cost of collection. Most cities specify the size of can, and where it must be left for collection. No standard type of wagon has so far been adopted in the U. S. cities, different cities employing different designs such as suit their ideas and requirements. The almost universal practice is to collect during the day. The frequency of collection depends entirely upon the amount of garbage, the density and character of the population, and the season of the year. The cost of collection is vitally affected by so many different factors that any attempt to compare the economy of a system in one city with that in another would generally be unsatisfactory. The cost of collection depends on the cost of loading, length of haul, capacity of wagon, rate of travel, grades, and traffic obstruction.

The methods adopted by different cities for the disposal of their garbage are: feeding to swine; dumping on land; dumping into large volumes of water; disposal by sanitary fill; burial; incineration; and reduction. Most of the smaller cities dispose of all or part of their garbage by feeding to swine The method is a most profitable one, and warrants consideration in small cities where isolated farm sites are available. Dumping on land, especially where there is a large quantity to be disposed of, is objectionable. Dumping in water is generally prohibited because the material is washed on a neighboring shore. The method of sanitary fill, in dumping the garbage and mixing with it sufficient earth to ensure oxidation, is not only satisfactory, and free from nuisance when properly carried out, but economical as well in filling excavations and ravines. Disposal by burial, when properly conducted, is sanitary, but is not applicable for large communities, on account of the large area of land required.

The system generally employed by large cities is a disposal plant, either by incineration or reduction. Incineration is favored for a city of less than one hundred thousand inhabitants. From estimates it has been found that the average cost of incineration is between $600 and $700 per ton daily capacity. The by-products of this process are clinker, used in brick manufacture and road-making, and heat that can be used for steam generation of light and power.

In the reduction method of disposal two processes are used—cooking and drying. In the former the garbage is cooked in large closed retorts by means of steam under pressure. In the drying process the grease is extracted by some volatile solvent like naptha. Reduction is a method that to be financially profitable can only be adopted in large cities. The cost of reduction will vary from $1,500 to $3,000 per ton daily capacity. Besides being sanitary, the reduction process is profitable in the intrinsic value of the components restored—grease, tankage, hides, etc.

The report is specially complete and valuable with regard to disposal by incineration and reduction. Liberal extracts from the data furnished under the headings are printed elsewhere in our issue of March 15 and of the present date.

The Recent Road Congress

The proceedings of the third Canadian and International Roads Congress, held in Montreal, were indicative of a strong interest in the good roads movement, partly due to the spirit created by the first Congress, also held in Montreal two years ago, but also very largely to the Good Roads legislation of the Provincial Governments. These governments gave the Congress very strenuous support; several members attended, and some of the speakers were officials in the highways departments. The efforts of the Gouin Ministry have clearly had very beneficial results in awakening interest in the improvement of roads, as was evidenced by the large number of delegates from that province. This was scarcely less noticeable in the case of Ontario and also Manitoba. The executive of the Congress met the desires of the section of the community in which the Congress was held by arranging for several papers to be read in French and by prominent French Canadians presiding at some of the sessions.

As compared with the First Congress, there was a marked all round improvement. The proceedings were more enthusiastic, the exhibition more attractive, and there was a general atmosphere of quickened vitality. The Congress was of real educational value, and will undoubtedly further stimulate the Good Roads movement. Rural municipalities are very hard to move, often looking upon such subjects as good roads in the light of unnecessary expenditure; the feeling expressed in the saying that what was good enough for their fathers is good enough now is still widely held by many men in farming districts, and it is difficult to upset deep rooted prejudices of this character. Such congresses as that held in Montreal are worthy of support, if only from the point of showing that good roads are profitable investments for the farmer, and the delegates who go back to their towns and villages impressed with this knowledge will help to remove one of the chief obstacles to the advance of the movement. Show the farmer that he is spending money to his financial advantage, and you have made a convert.

There were two or three points about the congress in connection with which one heard an occasional criticism. One was that the majority of the papers were too technical. To the engineers such papers are of great value, but the majority of the delegates were not of this class, and it is significant that the most popular speakers were men who mixed their technical data with more general observations. Then, again, several of the papers were criticised as being too long; they were weighted with too much detail, so that interest was apt to be lost by reason of the mass of information read off at a rapid rate. Delegates are apt to become wearied when a paper exceeds a reasonable limit, (except perhaps a few who have made that particular subject a study), especially when they have perhaps sat for an hour and a half listening to other papers. And finally, the discussions were on the whole, disappointing. Most of the papers passed without comment. This may in a degree be partly accounted for by the disinclination of the French Canadians to discuss the papers written in English, and vice versa, but even the papers in French were followed by little comment. The language question was one of difficulty, but it was met as fully as possible by Mr. B. Michaud, the president, alternating his speeches in French and English.

A Conference of Toy Manufacturers

With a view to encouraging the manufacture of toys in Canada, both for home markets and for export, a toy conference has been arranged to take place in the Royal Bank Building, King and Yonge Streets, Toronto, on the 28th of March. A large number of samples of German toys, such as were formerly imported into Canada, will be on exhibition to show Canadian manufacturers what the Germans supplied, and there will be a collection of U. S. toys also, which will indicate what our neighbors to the south have been doing to replace the German article. It is also expected that Canadian manufacturers of toys will send samples. There has been a very considerable development of toy manufacturing in Canada since the outbreak of the war, and it is known that there are not less than twenty-four toy factories in Canada at the present time. The importance of the industry and the wonderful demand at certain times of the year, would indicate the necessity of Canadian manufacturers attending this conference as a preparatory step towards holding this particular trade permanently.

Good Roads in Quebec

The Hon. L. A. Teschereau, Minister of Public Works, has presented a Bill before the Legislative Assembly of Quebec to abolish toll-gates on some sixty-four miles of road around the city of Quebec. The roads are at present owned by the Quebec North Shore Turnpike Roads Company, but the revenue from the toll-gates has not been sufficient to maintain the roads, and the company is practically insolvent. The Bill dissolves the company, and the roads and bridges are to be municipalized and become the property of the municipalities through which they run.

The Lieutenant-Governor-in-Council is empowered to create a commission of three men who will look after the road for ten years, at the end of which time the municipalities themselves will take charge. The money for repairs and construction is to be secured by the municipalities under the provisions of the Good Roads Act,—half the cost of maintenance is to be paid by the municipality, one-quarter by the city of Quebec, and the balance by the province, and the total cost of maintenance is not to exceed $40,000 a year.

Mr. Dunlop Before Ottawa Branch

The Ottawa branch of the Canadian Society of Civil Engineers held their third mid-day luncheon for the season in the Green Room of the Russell House on March 17th at which Mr. E. A. Dunlop, M. L. A., Pembroke, Ont., delivered a brief address. Mr. Dunlop has just returned from a trip to Europe where he visited the Canadian front line trenches. He was, therefore, specially fitted to give an account of the life and condition of our soldiers at the front.

Manitoba Branch C.S.C.E.

At a meeting held on March 3 of the General Section of the Manitoba Branch of the Canadian Society of Civil Engineers, Messrs. W. G. Chace and M. V. Sauer gave an interesting review of the present and proposed hydro-electric development in the Niagara Falls district. The differences in the various plants were pointed out, special features were discussed, and the advances made in electric power transmission within the last twenty years were dealt with.

The following list of members of the Manitoba Branch of the Canadian Society of Civil Engineers have enlisted for active military service:—

Lieut. Louis Annereau, A.M.; T. W. Clark, A.M.; W. S. Collins, S.; Major F. A. Creighton, M.; W. J. Dickson, S.; C. O. Donnelly, M.; Lieut. E. P. Fetherstonhaugh, A.M.; J. A. Hesketh, M.; Lieut. B. A. Johnston, S.; C. N. Mitchell, S.; Lieut. J. M. L. G. Mullon, A.M.; R. H. Mulock, A.M.; W. H. Richardson, S.; C. A. Millican, A.M.; L. M. H. Rime, A.M.; Major D. A. Ross, M.; C. Rowan, S.; Col. H. N. Ruttan, M.; G. L. Shanks, J.; W. H. Shillinglaw, M.; V. H. Tait, S.; Lieut. A. J. Taunton.

Monthly Meeting, Toronto Branch C.S.C.E.

The regular monthly meeting of the Toronto Branch of the Canadian Society of Civil Engineers was held in the Society's rooms at the Engineers' Club, 90 King Street West, on Thursday, March 9th. The meeting was devoted to the discussion of proposed amendments to the present by-laws as formulated by the Committee appointed in 1915 to consider this matter. While the attendance was not what the importance of the subject should warrant, a very interesting discussion took place, and many good suggestions were made. A stenographic report of this discussion will be available in a short time for members wishing to consult it. Mr. G. A. Mountain, of the Ottawa Branch, was present at this meeting, and contributed to the discussion.

Canada's total revenue to February 29, for the eleven months of the fiscal year, is $154,348,809. This is an increase of about $34,000,000 over a year ago.

The Monolithic Type of Brick Pavement

The advantages of this type over cushion construction — Description of methods employed

By Maurice B. Greenough*

THE development and successful application of the monolithic type of construction for brick pavements is a decided step in advance in improved highway construction. It promises the end of building roads by rules of thumb and precedent, and the beginnings of truly economical design and construction.

At the present time, the monolithic type is of two kinds, both representing a breaking away from the practice of constructing brick pavements in two parts, separated by a layer of foreign material, but one more gradual than the other. In one we have no radical change in the relationship of the various elements of the structure. It differs from the sand cushion type only in the addition of cement to the cushion course, producing a part which might more properly be called a cement mortar bedding course. A union is made with the finished surface of the concrete base, but it is only such union as may be obtained by bonding a thin layer of cement mortar to a prepared concrete surface, and to the bottoms of vitrified paving brick. The other, as typified by the newly built roads at Paris, Illinois, is a complete divorce from the old order. It represents the final step in consolidating the wearing surface and the foundation, so that both contribute their united strength to the structure. All semblance of a cushion or special bedding course is done away with, and the vitrified wearing surface is completely bonded to the green concrete base.

Before proceeding to a critical analysis of the results obtained by the two methods of monolithic construction, let us examine in detail the steps involved. First, that type in which the bricks are laid directly on the green concrete foundation, developed originally for country roads, but since applied to city streets. The preparation of the subgrade differs in no respect from that of any improved road. Thorough drainage must be insured and a uniformly compacted subgrade created as the foundation.

When the work begins, concrete of a quaking consistency is deposited from a conveyor on the subgrade between the forms. It is then roughly struck off by means of shovels to a depth about two inches greater than the required depth of foundation. The concrete having been deposited, roughly struck off, and spaded along the side forms in order to allow only mortar to come in contact with them, the foundation is struck off to a true surface and luted by means of a double template, in which has been placed a dry premixture of sand and cement in the proportion of one to four.

The character of the double template is of the utmost importance and may well be called the salient feature of this method of construction. As developed at Paris, Ill., and very successfully used there, it consists of a forward cutting edge, an I-beam, and a rear cutting edge, a channel with the flange placed outward. The I-beam and the channel are spaced from two to three feet apart. The bottom of the rear cutter is about three sixteenths of an inch higher than the lower edge of the forward cutter. With the space between the two filled with dry sand and cement, a forward motion of the template first cuts off the concrete and then fills all irregularities in the surface with the luting mixture.

Sufficient water is used in mixing the concrete so that enough will work to the surface and be absorbed by the luting mixture to insure its thorough hardening.

The surface thus created in the rear of the template is remarkably smooth, entirely free from depressions, and is ready to receive at once the brick surface. No difficulty has been experienced in laying the brick in the usual manner, having them brought in on pallets with the best edge upward, the dropper standing upon the brick just laid. There is sufficient rigidity in the green concrete base even at this stage to resist the formation of any depressions in the surface by workmen moving about upon it. It is well, however, to have boards laid for the men to walk upon.

The brick setting is immediately followed by rolling. A light hand roller weighing from four to five hundred pounds has been found entirely adequate to obtain a remarkably smooth surface, in fact, the surface obtained before rolling is as smooth as many sand cushioned streets after rolling.

Fig. 1.—Brick pavement without curbing.

The chief endeavor of highway engineers is to obtain economy in construction, to build pavements for the minimum cost that will promise the maximum of durability, consistent with all the elements that govern pavement construction such as drainage, traffic, and freedom from excessive maintenance and repair. If we compare the two methods of building monolithic brick pavements on the basis of results already demonstrated, we find that the sand cement mortar type has

*Instructor Highway Engineering, Case School Applied Science, Cleveland, before Ohio Engineering Society.

increased the cost of construction, while that method by which the brick are placed on the green concrete base has decreased the cost of construction.

In the sand cement mortar bed type, the base is prepared in advance and allowed to harden exactly as if the sand cushion type were to be built. The same depth of brick is used and the same concrete edging or curb has been retained that were formerly employed. The increase in cost arises through the introduction of the cement in the cushion material. Any saving in the amount of sand used and in allowing faster dropping of the brick is offset by the cost of the cement and the cost of premixing the cement and sand. The net result is an increased cost per square yard for the construction. The sand cement mortar bed type has had its widest appreciation in city practice. One of the advantages of the Paris type is found in the elimination of the curbing or edging for country roads, so that from the point of view of effecting economy in materials this type has the advantage over the sand cement mortar bed type.

Fig. 3—Bricks removed from pavement.

Any innovations in pavement construction methods are of interest to the engineer particularly, since it is he who forms the connecting link between the contractor and the taxpayer. But the contractor is vitally concerned in these innovations since it is he who must adapt his organization to them in order to meet successfully the requirements of the engineer. The public is interested by reason of the fact that it is they who pay for all pavements constructed and enjoy the use of them. Therefore, in order to satisfy all of these interests, a pavement must be of practical construction in the operations and organization involved, it must meet the requirements of all pavements, that is, ease of traction, ease of cleaning and durable under the wear and tear of traffic, and finally it should be attained at the minimum expenditure of money consistent with good service.

Executives are agreed that the maximum efficiency in operation and organization obtain when the same men continue to exercise the same functions, in other words, specialization of effort. What holds, for example, in productive industry, is equally applicable to the construction of pavements. Effective effort on the part of workmen building a road is obtained when each man becomes thoroughly familiar with the work which he has to perform, and particularly if he has but one kind of work to do.

Again, economy in materials, which decreases the amount of money which must be tied up during the prosecution of a contract, appeals strongly to the contractor. A type of construction which promises to be a credit to the man performing the work and one in which the hazards of unknown and unforeseen circumstances are reduced to a minimum commends itself strongly to the contractor.

Fig. 2—Completed brick pavement, Paris, Ill.

All of these conditions are satisfied by the Paris type of monolithic construction. The entire force engaged in building the pavement is distributed over a distance of less than seventy-five feet along the road, encouraging economy by making possible street supervision of all the work. The same men perform the same operations continually. For instance, certain men are always engaged in roughly striking off the concrete base and spading it about the forms; others are mixing the sand and cement luting course and keeping the template well filled; still others are constantly bringing in brick for the droppers, and so on. Thus the entire operation proceeds at a uniform rate of speed throughout the day. There is no confusion or loss of time by changing duties. Economy in materials is effected by the elimination of the curbing or edging in country road construction. A saving is made in the amount of sand and cement required for the luting course over what would be required for a sand cement mortar bedding course, or even a plain sand cushion.

No time is lost in waiting for a concrete base to harden before brick laying may commence. In other words, there is no call for equipment to be brought on to the work until actual operations of constructing the pavement begin. Of course, the subgrade must be prepared, but except in unusual circumstances that may be going on simultaneously with the construction of the pavement only far enough ahead so that no time will be lost by breakdowns or other unforeseen delays in preparing the subgrade.

In the use of the special template which both strikes off and lutes the concrete foundation is found the critical point in construction. No make-shift template should be employed, it should be substantial and designed particularly for the work to be performed by it. The cost of the template is very small in proportion to the economy effected by its use.

Every engineer hesitates to commit himself to new methods of construction, involving the expenditure of large sums of money without being certain of the ground upon which he stands, in order that his name shall not be lent to any plan which may later result in discredit to his professional judgment. This is a natural and justifiable attitude and it serves as a check on exploitation and over zealous attempts to improve methods which have been in use for many years. Unfortunately, we do not as yet have in highway engineering the criteria for predetermining pavement behavior under the diversified conditions of application which surround them, so that opinions upon the future performance of pavements must be based upon "a priori" reasoning, with past performances of accepted methods in view.

The principal defects of the sand cushion type of brick pavements have been longitudinal cracks and surface depressions, caused by soft spots or shifting in the sand cushion, by imperfect grouting, or combinations of the two effects. The presence of moisture in the sand cushion which may freeze and expand during cold spells may also be a contributing factor in the formation of longitudinal cracks. One thing is certain, that the elimination of the sand cushion eliminates its hazards as well, and defects that develop must be attributed to some other source. So far, no longitudinal cracks have developed in monolithic pavements.

The opinion of engineers has been expressed from time to time that they feared that at the end of five or six years, the bricks would become broken and battered on account of the anvil effect of the base when the surface is subjected to moving loads.

We know that the ability of any structure to withstand the shock of suddenly applied loads depends upon the ability of the material to yield slightly and to store within itself internal energy equal to the amount of the external energy applied to produce the given state of distortion. This storage of internal energy is evidenced by the elastic recovery of the structure to its original position upon removal of the load. We commonly describe this function of a pavement as its resiliency. Just what the resiliency of a four-inch brick surface firmly united to a four-inch concrete base will be, is something to be determined by actual measurement.

A careful study of monolithic pavement leads to the conclusion that they are inherently stronger, and better suited to withstand successive deflections without injury than is that type having the wearing surface and the foundation acting separately, the only connection between the two being dependent upon a layer of sand which may or may not establish a contact.

The taxpayer's interest in improved roads lies not only in having a smooth and comfortable road over which to ride, but also in how much he must pay to secure such a road. His interest in monolithic construction is quickened by the knowledge that a type of construction for brick roads has been developed which promises to be equally and probably more satisfactory than the sand cushion type, and as has been indicated by work thus far performed, it is secured at a cheaper price.

Cost of Applying Mortar with the Cement Gun*

The upstream face of the Elephant Butte dam of the United States Reclamation Service is being waterproofed with portland cement mortar mixed in the proportion of one part cement to two parts sand and applied with a cement gun in a coating about 1 in. thick. Advantage has been taken of rising water in the reservoir to work from rafts specially constructed for the purpose. There are two of these, each 9x13 ft., made of planking on a framework laid on and attached to 16 oil barrels. One raft contains the machine, operator and helpers, small mixing box and a few sacks of cement and sand, while the other is loaded with cement and sand.

The coating is applied in horizontal strips about 10 ft. high and the length of the dam at water level.

Fig. 4—Laying brick, Paris, Ill.

The surface is first cleaned thoroughly with scrapers and wire brushes and is then gone over with a sandblast, using coarse sand, passed through the machine to obtain the necessary pressure. This roughens the surface sufficiently to cause the mortar to adhere to it. The surface is then thoroughly moistened with a hose and the mortar immediately applied. The mortar is put on in four layers, each about ¼ in. in thickness. It was found that a thicker coat than this applied on a vertical wall, without reinforcement, would, on account of its weight, slough off before setting. Each

*From the Reclamation Record.

layer follows the preceding one before it has attained its final set, and so far there is no indication of a parting of the layers. Numerous samples taken from the face showed perfect adhesion to the concrete, it being impossible in every case to break the mortar from the concrete at the line of contact. The cost per square foot for the first 100,000 sq. ft. of this coating is as follows:

Operating and repair work, including cost of air and water	$ 0.015
Staging, cleaning wall, moving, etc.	.006
Cement	.024
Sand, including labor, screening and hauling (sand only 20c per cu. yd.)	.007
Depreciation of gun and equipment	.020
Subtotal	$ 0.072
Overhead	.007
Total cost per square foot	$ 0.079

In using the cement gun the sand must be clean, sharp and not too fine. It must not be bone-dry, or trouble with feeding will occur. The air pressure should be about 30 lb. in the gun and the water pressure over 60 lb. It has been figured at Elephant Butte that 30 ft. of free air at 100 lb. pressure at the point of delivery to the gun and 10 gal. of water are required per minute.

Efficiency in Municipal Engineering

By R. O. Wynne-Roberts

IN the article published in the issue of February 9th the writer dealt with the question of efficiency in municipal engineering in general. Since then I have had the opportunity of studying the financial returns of nearly 60 Ontario waterworks as published in a government report for 1913, which is the latest available.

The returns do not appear to be rigorously standardised because in a number of instances the repayment of loans or debentures is included in the annual working expenditure. It would also appear that these repayments are included in other returns although the fact is not stated. Furthermore the dissection or allocation of the accounts in some of the returns do not conform to the standard and, therefore, must be omitted. These conditions are to be regretted, inasmuch as the data given would be of great value to the authorities in order to compare the results obtained in one place with those in another. Such a comparison, however, is not always reliable unless ample information is available as to the nature of the power employed, cost of fuel, type and condition of the pumps, average height to which water is raised, management and operating organizations, and so on.

A professor addressing the Royal Canadian Institute in Toronto recently, referred to "the mendacity of statistics," and without doubt he was stating a truism, for figures without explanations are often most misleading. For example, the cost of providing water by pumping in Ontario municipalities including all expenditures, excepting the repayment of loans or debentures, ranged from $14.00 to about $138.00 per million gallons. This great difference needs explaining and when the average daily consumption is taken into account it is found that it will give a little light. Where the total cost of pumping was only $14.00 per million gallons pumped, the average daily quantity of water per head was as high as 437 gallons, but where the cost was $138.00 the consumption was only 33 gallons. The ratio of the two consumptions was as 13 is to 1 but the cost of production of water was as 1 is to 10. The cost of water production, however, does not mount up in the proportion of the quantity used and wasted. Labor, repairs, salaries, interest, etc., will remain nearly the same, but fuel or electric energy will cost nearly in the same ratio as the quantity of water supplied. Suppose the working expenses, etc., are analysed on the basis of the population, which is the only other basis available in this case, as no statistics are given as to the number of actual customers supplied. The following table furnishes the main items of the year's operation at the above two places, based upon (a) per million gallons supplied and (b) per capita:

	Gross cost	Fuel or Energy	Salaries or Wages	Interest	Gross Earnings	Gallons per head per day
(a) per million gallons –						
1	$ 14.00	4.26	3.58	2.30	16.80	437
2	138.00	9.00	29.50	62.00	213.00	33
(b) per capita –						
1	$ 2.31	0.684	0.574	0.306	2.69	437
2	1.65	0.1078	0.352	0.744	2.55	33

It will be observed that No. 2 would appear to have a very costly water supply if the cost per million gallons is taken as the standard, but when compared on the basis of cost per capita it is the most satisfactory on almost every score. These two places are relatively small, one has a population of over 2,000 and the other over 4,000.

If the same analytical method is applied to larger towns we get the following results:

	Gross Cost	Fuel or Energy	Salaries or wages	Interest	Gross earnings	Gallons per head per day
(a) per million gallons –						
3	$ 57.00	17.50	11.70	14.10	96.00	57
4	46.00	5.20	6.04	26.60†	57.20†	143
5	62.00	6.80	7.70	30.50	84.00	100
(b) per capita						
3	$ 1.18	0.36	0.32	0.29	1.99	57
4	2.40	0.27	0.314	0.93†	2.99†	143
5	2.28	0.25	0.282	1.448	3.05	100

†Includes repayment of loan.

In these instances again the cost of water per million gallons supplied is inversely proportional to the average daily consumption; whilst if based upon the number of inhabitants the cost was lowest where the consumption was low. There are, however, many local circumstances which would tend to alter the above figures, but in the absence of particulars it was impossible to consider them. In most Canadian towns and cities there are some people who have independent water supplies from wells, etc., the number of which is often proportionately greater in a small town than in a large city. Some towns use large quantities of water for public purposes and the industrial use of water in small towns is frequently greater in small towns than in large ones, when compared on the per capita basis.

The financial returns from Ontario towns were analyzed in several ways so as to ascertain the relative cost in different places. The tables built up in this way are too extensive for publication but they indicate that some authorities could save money and at the same time probably have a more efficient water system.

The average daily consumptions, according to the returns, range in a crescendo scale from 29 to 437 gallons per head. Out of 39 towns who reported the consumption

35 consumed over 40 gallons per head per day
32 consumed over 50 gallons per head per day
31 consumed over 60 gallons per head per day
28 consumed over 70 gallons per head per day
27 consumed over 80 gallons per head per day
23 consumed over 90 gallons per head per day
20 consumed over 100 gallons per head per day
7 consumed over 150 gallons per head per day
5 consumed over 200 gallons per head per day
4 consumed over 250 gallons per head per day

There may be excellent reasons for some of the high consumptions, such as industries requiring large quantities of water which are metered and paid for.

If certain U. S. and European manufacturing towns can prosper on 40 gallons or less per head daily, it is evident that 50 gallons should suffice in Canada. As the daily consumption is allowed to mount up it is palpable that the waterworks plants must be sufficient in capacity not only to cope with the regular requirements but also for fire purposes. If the ordinary flow of water through the pumps, filters, reservoirs and mains is two or three times that which is actually necessary, it is easy to anticipate the conditions obtaining when a large supply is required for fire extinction. The capital necessary to be spent to satisfy all these requirements must be great or an inadequate service is provided. It does not matter which, because the ratepayer must pay either in interest or expenditure and for operation expenses, or as surcharge on fire insurance. But if the waterworks system is in a proper condition the ratepayer has neither excess to pay, because by maintaining the plants in a high state of efficiency they are capable of meeting all contingencies at the minimum of cost.

By allowing the water consumption to mount up not only has the ratepayer to bear the extra cost of pumping and extra interest on plant, but the extra water that is allowed to be used and misused simply adds to another burden, namely that of disposing of the sewage. The quantity of sewage to be dealt with is more or less proportional to the volume of fresh water supplied, but the organic matter in sewage is roughly proportional to the population served. Certain features of sewage treatment plants depend more upon the strength of the sewage rather than upon the volume, but this subject need not be discussed further in this connection.

The ratepayers have always to pay for these services, and the point the writer desires to emphasize is that it pays directly and indirectly to avoid waste of water, energy, fuel, labor, and therefore money. Preventable waste, and efficiency are two elements—like oil and water—they will not blend well, if at all.

Unfortunately the returns are incomplete in several respects, consequently it is not possible to include all of the waterworks in this discussion. It is nevertheless interesting to note that out of 20 towns which gave no data as to the daily average consumption per head, 10 had made a profit on the year's operation and 10 had deficits. Where the daily consumption was under 50 gallons per capita one concern had a deficit, four had surpluses. In the towns where the consumption was under 75 gallons per head there were losses in two and surpluses in 7 of them. Carrying the investigation further it was found that with a daily consumption of 100 gallons and less 3 waterworks were run at a loss and 11 with profit, whilst in those towns where the people required more than 100 gallons per day there were 6 waterworks run at a loss and 14 profitably. It will thus be seen that as the consumption per capita mounted up the undertakings operated at a loss increased in number. Out of 54 towns 19 had suffered losses and 35 made profits.

The capital expenditures on waterworks based upon the reported assets were as follows:

		Capital expenditure per capita	Daily Consumption per capita
Cities over 10,000 inhabitants—			
Maximum	(6)	$ 95.30	120
Minimum	(3)	20.60	57
Average		33.45	113
Cities or towns under 10,000 inhabitants—			
Maximum	(7)	$ 51.00	145
Minimum	(8)	7.55	——

Unfortunately, as already stated, the information given in respect to the annual capital charges is indefinite, but if we eliminate those returns which specifically state that repayments of loans or debentures are included in the cost of production we find that the interest charges ranged from $10.70 to $82.20 per million gallons, that is as 1 is to 7.70, or from $0.13 to $3.60 per capita, that is as 1 is to 28. It is known that certain towns have not installed or maintained adequate and efficient water supplies and the above figures tend to prove it.

The cost of fuel and energy in cities of over 10,000 inhabitants differed considerably but in smaller places the range was much greater, as will be seen below:

Cost of Fuel and Energy per Million Gals.	Consumption per Head per day		Cost of Fuel per cap.	Consumption per head per day
		Cities over 10,000 pop.		
(3) $17.50	57 gals.	Maximum	(6) $0.59	120 gals.
(9) 5.20	,143 gals.	Minimum	(5) 0.25	100 gals.
		Cities under 10,000 pop.		
(10) $50.00	29 gals.	Maximum	(12) $1.04	85 gals.
(11) 3.04	356 gals.	Minimum	(13) 0.116	150 gals.

The cost of fuel and energy varied greatly. Some towns have water power available to operate the pumps and as far as the writer's information extends they have not been included in the analyses. When water power is utilized the cost of energy and fuel is reduced but in the absence of figures as to the ratio of water power to steam, electric, oil or gas power no good purpose can be served by pursuing this study.

Salaries and wages amounted to an average of $10.31 per million gallons in cities of over 10,000 inhabitants. They ranged from $4.24 to $20.00. When distributed over the population they amounted to an average of $0.41 per capita ranging from $0.28 to $0.62. In smaller cities and towns this expenditure ranged from $2.36 to $42.50 per million gallons, or $0.13 to $1.19 per capita.

In conclusion it must be clearly understood that the data obtained from the published government report may be subject to considerable revision when the balance sheets for 1915 are analysed. Furthermore the figures quoted herein are used to illustrate the possibilities for reductions in cost of operating waterworks, especially in smaller towns. The ratepayers are ordinarily favorable to the municipalising of public utilities, on the supposition that the services are rendered at cost price and evidently they are. But in many places it is also evident that some of the waterworks would be operated by companies in a different manner and at less cost to the consumers.

The writer has during his professional career consistently advocated the municipal ownership of public utilities, but according to some of the returns there are occasions when the public would receive better service at a lesser cost. In view of the present financial situation when thrift, economy and efficiency count as they have seldom done before, it is important that the exhortations of the governments should be respected even in the management of public utilities. But apart from the need for public frugality it is the natural attitude of customers to strive and get their supplies of commodities at the most economical terms. Water is an absolute necessity; public health, private amenity and general requirements are such that its supply should be pure, abundant and cheap, but such conditions are difficult to maintain without efficiency in the several departments of water undertakings.

Shot Tower for Canada Metal Co.

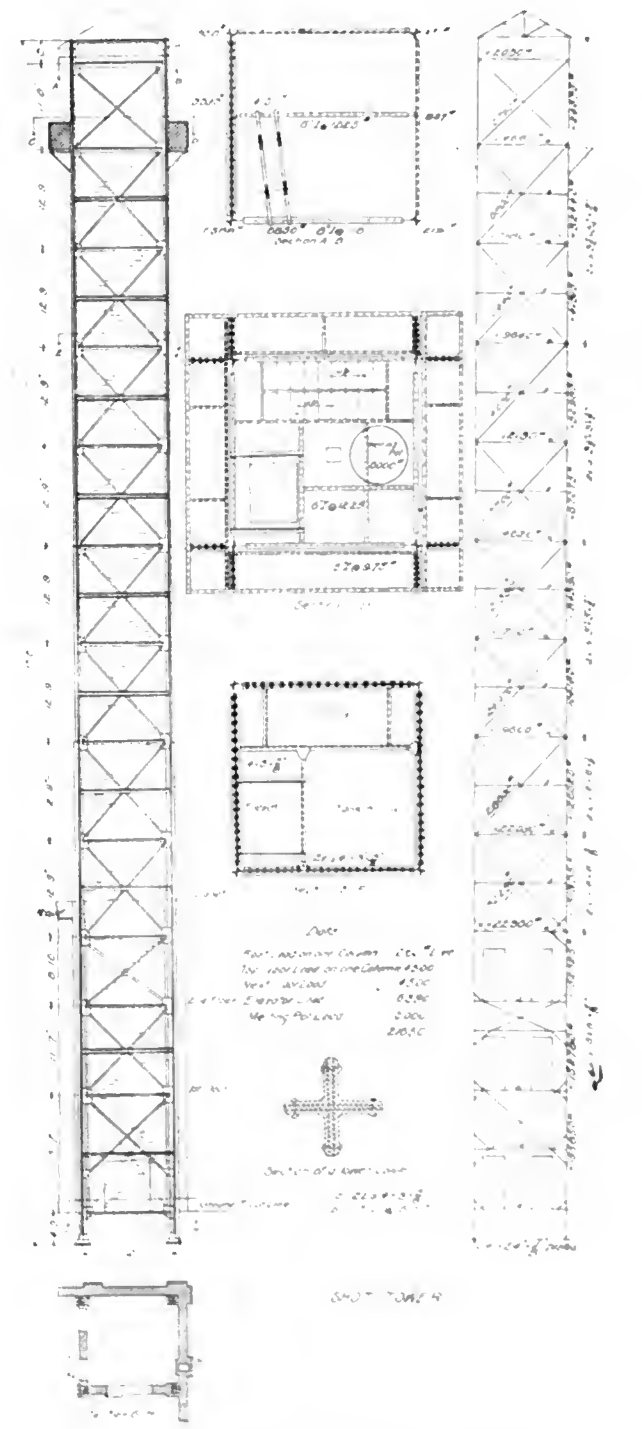
The Canada Metal Company, of Toronto, have let to the Ontario Wind Engine and Pump Company the contract for a shot tower to be built in connection with their new factory. The tower, which is still in the latter company's shops, will, when erected, be 160 ft. high, 12 ft. square, and be closed in with a corrugated iron sheathing. Erection will be commenced as soon as all the members are fabricated in the shops.

In designing the tower special attention had to be paid to bracing for wind loads—a factor very seldom considered in large flat buildings. This is necessary, not so much from any excess of weight, but from the excessive height of the tower relative to the width of the base. In fact, in designing the tower the wind load was the determining factor in the size of the members.

On account of the limited foundation space, the tower was built 12 ft. square and was kept uniform throughout, rather than using a larger base with a design tapering towards the top. This necessitated using heavier members, especially in the bottom panels, to get the same strength. The tower is built in an exterior corner of the factory, and is accessible from the different floors of the factory. This fact eliminated any bracing in the lower panels on that side as high as the factory roof. To overcome any danger from failure, the columns were built heavy enough to ensure a large factor of safety. To meet these several conditions the column members, as high as the factory roof, were each built of four 6 in. by 6 in. by ⅝ in. angles plated together, star connection, see figure. Beyond this two angles riveted back to back were used.

To meet the heavy overturning effect, the foundation for the shot tower, which was built simultaneously with the factory foundation, was made fairly massive, and to distribute the load under each pedestal over as large an area as possible, was built of concrete iron grillage. The foundation walls are 12 ft. square, 3½ ft. thick, and nearly 20 ft. deep. Eight 2-in. bolts were embedded in the concrete to firmly secure the tower. The total estimated weight of the tower is about 90,000 pounds.

On the top floor (see section C-D) is placed the melting pot and screens, with sufficient floor space for workmen, and around the tower is built a three-foot balcony. Material is elevated by means of an elevator, approximately 3 ft. by 4 ft., operated by machinery placed just to the north of the shot tower. A pair of stairs also leads to the top floor. Shot metal, on being elevated to the top floor by the elevator, is melted and poured through screens of the proper mesh, according to the size of shot required, and caught in a tank of water at the bottom. The liquid streams, in dropping through space, form into spherical globules, and are hardened when they hit the water.



Plans and sections for Shot Tower, showing wind loads in the different members

Creosoted Wood Block Pavements

Preparation of Blocks — Methods of Laying — Maximum Grades—First Cost and Maintenance

By Andrew F. Macallum, C. E.*

For a number of years untreated wood block pavements were laid in this country and the States and after repeated failures attention was directed to the use of preservatives. The first experiments made simply placed thoroughly dried blocks in a bath of creosote heated to a temperature of about 210 degrees F. until three pounds per cubic foot of creosote had been absorbed. While these pavements were fairly successful it was soon realized that the best results could not be secured by merely dipping the blocks and they were then treated with creosote under pressure until they absorbed from ten to twelve pounds of oil per cubic foot. Such a pavement laid in Indianapolis in 1898 gave such good results that city engineers began to appreciate the possibilities of treated wooden blocks and better results were obtained.

A small piece of wood block, treated with the creo-resinate process composed of one half creosote oil and one half resin, was laid on the west side of Yonge Street, Toronto, at Front street opposite the head office of the Bank of Montreal in 1896 and was still in good condition when taken up for a new pavement about two years ago. In the City of Hamilton probably more treated wood block pavements have been laid than in any other city in Canada and the first pavements put down in 1909 are as good yet as when laid, and although subjected to the heaviest kind of traffic have not to date cost a cent for maintenance. It has also been laid on residential streets where the residents assume its greater cost to asphalt for the added comfort through its quietness under traffic.

Types of Wood Used

The wood principally used has been Long Leaf (yellow) Southern pine which from experience has been found to give excellent results. Most specifications, now, however, admit Norway pine and tamarac as a result of experiments made on pavements laid in Minneapolis, which showed the suitability of these woods. No doubt other species of wood make satisfactory pavements but on account of the incomplete knowledge of their value as paving blocks city engineers as a rule prefer a wood that has been proven satisfactory. Blocks are generally from three to four inches wide and vary in depth from three to four and one-half inches and in length from 5 to 10 inches. The depth of blocks should not vary more than one sixteenth of an inch for a given size. As for all timber specifications the blocks should be sound, free from large or loose knots, shakes, worm holes and other similar defects. The annual rings are usually specified to average not less than six to the inch and the blocks to average 80 per cent. of heart wood or one block not to have less than 50 per cent. heart wood. The preservative used is usually a pure coal tar product free from petroleum oil or its products having a specific gravity of 1.10. Water gas tars have not proven satisfactory and should not be used.

With a view of obtaining opinions as to the most satisfactory amount of treatment required per cubic foot of block according to the experience of each city the writer has ascertained from replies from twenty cities in the United States that six of these cities use 16 pounds, two of them 18 pounds, and twelve of them 20 pounds depending to some extent on local conditions. The percentage of treatment will vary with the block as the denser and heavier the block the smaller is the quantity of oil which it absorbs. The sapwood will absorb a large percentage of the oil but if the block has not had the moisture first removed from the sapwood the oil will not be able to penetrate the block. Thus it is invariably found that a block which fails does so in the sapwood and the cause is an insufficient amount of oil or poor penetration of the sapwood.

* City Engineer, Hamilton, Ont. Before Good Roads Congress, Montreal.

Laying the Pavement

The base for wood block pavements should be of concrete from five to six inches deep, having the crown parallel to the required finished crown on the blocks. An uneven or irregular base is detrimental to any pavement as it is liable to cause a depression in the surface which the repeated impacts of waggon wheels is certain to increase, giving an uneven surface. Upon this concrete base is placed either a sand or mortar cushion, usually one inch deep with its surface struck by templates to a surface parallel to the contour of the finished pavement. Where sand is used it should be such that it will all pass through a quarter inch screen, besides being clean. When a mortar cushion is used, some engineers use a proportion of one of cement to three of clean sand to which sufficient water is added to insure the proper setting of the cement, while other engineers obtain good results by mixing and placing the cement and sand dry. This cushion is simply a means of securing a uniform surface for the blocks to rest upon and distribute the load. Alongside or between street car tracks, however, or on grades, sand cushions are apt to become uneven or flow due to the vibration of the rails or by water getting in alongside the rails, and washing the sand out, so that under these circumstances a concrete cushion should be used. Away from the car tracks the question of whether a sand or mortar cushion should be used is a matter of opinion. Sand gives a better cushioning effect and the blocks do not have to be rolled so soon after laying as when a mortar cushion is used, but the present tendency seems to favor a mortar cushion.

European practice does away with this cushion altogether, but the concrete base is finished off as smooth as a concrete sidewalk and to the exact contour of the surface of the pavement. This extra care and workmanship obtain results that are excellent in as much as the finished surface of the blocks have no depressions and consequently the wheels cause no impacts. In some cities it is not always possible to lay the blocks shortly after coming out of the treating plant, and the hot sun and wind, during shipment and the idle period before laying, is apt to check the blocks and cause the oil to exude. The blocks should be piled closely when delivered on the street and sprinkled or dipped in water before laying.

Expansion Joints

Generally the blocks are laid at right angles with the curbs with an expansion joint at each curb of from three quarters to an inch and a half according to the width of the pavement. Alongside the curbs three rows of block are laid parallel to the curbs with the expansion joint next to the curb. Placing a longitudinal row of blocks with an expansion joint on each side is sometimes done, but is not good practice as the single row of blocks between the joints will almost certainly rise up above the level of the adjoining pavement as the joints close up. Cross expansion joints have been used also by the writer when the treated blocks had been piled on a street for several months, but for fresh blocks properly treated they are not necessary on streets of heavy traffic. On streets of light traffic, however, there should be cross expansion joints placed from thirty to fifty feet apart and having a width of about three quarters of an inch. It is hardly necessary to say that the blocks should be laid with the grain vertical and having the joints in adjacent rows, broken by a lap of about 2 inches. The blocks should be laid neither too loose nor too tight, about one-eighth of an inch apart, so that a block can be raised without disturbing the surrounding blocks.

Roll the Surface

After the pavement is laid it should be rolled thoroughly with a roller varying from three to five tons until a perfect surface has been secured with no depressions and the blocks firmly in place. There should be no difficulty in this as the usual specification for blocks allows of a variation of but one sixteenth of an inch in depth so that if the foundation and cushion have been properly laid there is usually very little trouble about depth of the blocks. Alongside street railway tracks and about manholes special care should be taken in laying the blocks. It is usual in such cases to thicken the cushion so that the blocks shall be about one quarter of an inch above the wearing surface of the rail or cover and in a very short time the traffic will rub these blocks down to the level of the rail. Alongside rails, to prevent water flowing down and under the blocks, two methods are used: one is to place specially cut creosoted plank under the rail head to give a vertical surface against which the blocks are paved and the second and usual method is to plaster the web with a rich mixture of sand and cement to the width of the rail head and the blocks are then laid against this. As with other pavements it has been found that the girder lip rail is more satisfactory than the ordinary tee rail, unfortunately in use in most towns, for the permanence of the block on the inside or gauge side of the rail. Incidentally it may be said that no pavement will be satisfactory alongside a street railway track if the rails lack sufficient weight, stiffness and foundation to prevent movement especially at the joints.

Joint Filler

There is a diversity of opinion among engineers as to the best joint filler to be used. The American Society of Municipal Improvements recommend a suitable bituminous filler when the blocks are laid upon a sand cushion and a sand filler when laid on a mortar cushion. It is claimed for the bituminous filler, which fills the joints between the blocks about two-thirds their depth (the remaining depth being filled with sand) that it makes an absolutely waterproof pavement and that it eliminates all expansion difficulties as such block is surrounded with an individual expansion joint. Unless the filler is a suitable asphaltic cement with a high melting point and low penetration there is apt to be a sticky surplus left on the surface. This filler will cost about 15 cents per square yard more than a sand filler.

A cement grout filler has been used but unless the traffic can be kept off the pavement for at least ten days it is little better than a sand filler. The sand filler is generally used on streets of heavy traffic; the sand being coarse and sharp grained, and preferably heated before placing. The writer has used with excellent results a bituminous filler between, and one foot outside, of street railway tracks and a sand filler to the curb where three rows are again treated with a bituminous filler. From results obtained he does not consider the extra expense in using bituminous filler justified for such streets unless the traffic be very light. On bridge floors it is better practice to use a bituminous filler with the blocks. After the pavement is rolled sand to the depth of about a quarter of an inch is spread over the surface and the street is thrown open to traffic.

Maximum Grades

This method of construction is satisfactory up to a three per cent. grade, beyond which the blocks are laid in a different manner. The crown should be as light as possible, being just sufficient to shed the water freely, which applies also to the pavements between street railway tracks. When the grade of a proposed pavement exceeds three per cent. the question of a suitable pavement, and the method to be adopted in laying it, to meet the requirements of the traffic, becomes of interest. With the variability of conditions to be met with due to our climatic changes the limits of most paving material are soon reached, so far as the inclination of grade is concerned unless specially manufactured.

The writer inquired from twenty-four cities to ascertain the maximum grades upon which creosoted wood block had been laid and found that one city had laid this pavement on a seven per cent. grade, one on six per cent., three on five per cent., and five on three per cent. grades. The five to seven per cent. pavements were laid under two methods: The first method used was probably originated in the city of Hamilton and was used on upper James street where a block pavement was laid in 1909 on a five and a half per cent. grade. Each block had a strip one half inch in width and one half inch in depth cut off one face so that when the blocks were laid at right angles to the centre line of the street there was a space of a half inch between each row of blocks giving a good foothold for horses drawing traffic. These blocks were pitch filled and the cross grade of the street was sufficient to drain out any water. The same method was adopted on King Street west in the same city, during the same year, and I may say that both of these pavements have been very successful in meeting the conditions of heavy traffic on two of our main streets without a cent being spent for repairs or renewals since being laid.

Special Type of Blocks

The special cutting of the blocks in the manner described added considerably to the cost of the pavement and to obviate this the ordinary rectangular block was used with creosoted laths 5/8 in. x 2 in. laid between each cross row of blocks. This was pitch filled as in the first method and has been just as successful, being today in first class condition although subjected to fairly heavy traffic for four years.

On Ravenscliffe Avenue, Hamilton, a purely residential street, having a 6 per cent. grade, blocks spaced in this manner were laid. The reason for putting such a pavement on a street like this having very little traffic was that the residents insisted on a creosoted wooden-block pavement because of its quietness as compared with other pavements suitable for such a grade and it has fulfilled expectations.

Slipperiness

One of the criticisms made of treated wood block pavements is that it is slippery, but in the writer's experience he has found that there is very little difference between these blocks and sheet asphalt pavements. When covered with a light frost or snow, or when the weather is foggy and damp the pavement may become objectionably slippery. In traffic observations made at Philadelphia, Newark and other cities the evidence shown by the engineers at these places indicated that where treated wooden block and granite blocks were on parallel streets 70 per cent. of the teaming went on the wooden block. On Stuart street in the city of Hamilton the writer laid treated wooden blocks between the street car rails and granite block between the outside rails and curbs, the pavement being on a 5 per cent. grade. Although most of the traffic was of a heavy truck teaming nature it was found that fully 80 per cent. of the traffic except on wet days was on the wooden block.

First Cost and Maintenance

The first cost of wood block pavement is undoubtedly higher than that of most of the other paving materials; averaging in the City of Hamilton from $2.85 to $3.00 per square yard, exclusive of grading. When its cheapness of maintenance, ease of cleaning, low tractive resistance and durability are taken into consideration this pavement with its relatively high first cost will compare favorably and prove ultimately cheaper than one lower in first cost.

New Administration Building for Board of Education, College Street, Toronto

The fine new Administration Building, the new home of the Board of Education which is to be ready for occupation this year, is well ahead of its schedule. The Building is practically completed under the existing contracts which include the general construction, and the City has been asked to appropriate further for completion of the interior finish and fittings.

The building is situated on College Street, with the Main Facade directly opposite the University Group of Buildings, with a side entrance off a private driveway on the west.

The architecture is of a simple Classic Greek design. The feature of the main Facade is an Ionic Portico surmounted upon the heavy rusticated base

Fig. 1—Front Elevation, Administration Building, Toronto.

enclosing the principal floor. This Portico is flanked by two end pavilions, the whole supporting an attic storey.

Immediately under this Portico, the main entrance is situated which is a handsome modern adoption of the famous Erechtheion doorway. The spandrils between the stone columns are treated in Ornamental Cast Iron fitted with metal casements.

The building which is of fire proof construction is of skeleton steel frame, fireproofed with hollow tile and carried on concrete piles far below the surface of the ground, owing to the site being over the old Sleepy Hollow Creek. All floor and interior partitions are of hollow tile.

The material used throughout is a common grey stock brick with a recessed joint relieved with trimmings and Portico of Indiana limestone which makes a very successful combination.

The general treatment of the interior is very plain except the main entrance hall on the principal floor, the Members room and the Board room, which are treated to suit their respective importance.

The main hall has a simple plaster wall treatment relieved by ante-pilasters and supporting an entablature and deep panelling ceiling.

The axial line of the entrance leads to the handsome bronze enquiry wicket; adjacent to this is the elevator and staircase.

The enquiry wicket will be in touch with all parts of the building with an up-to-date telephone system.

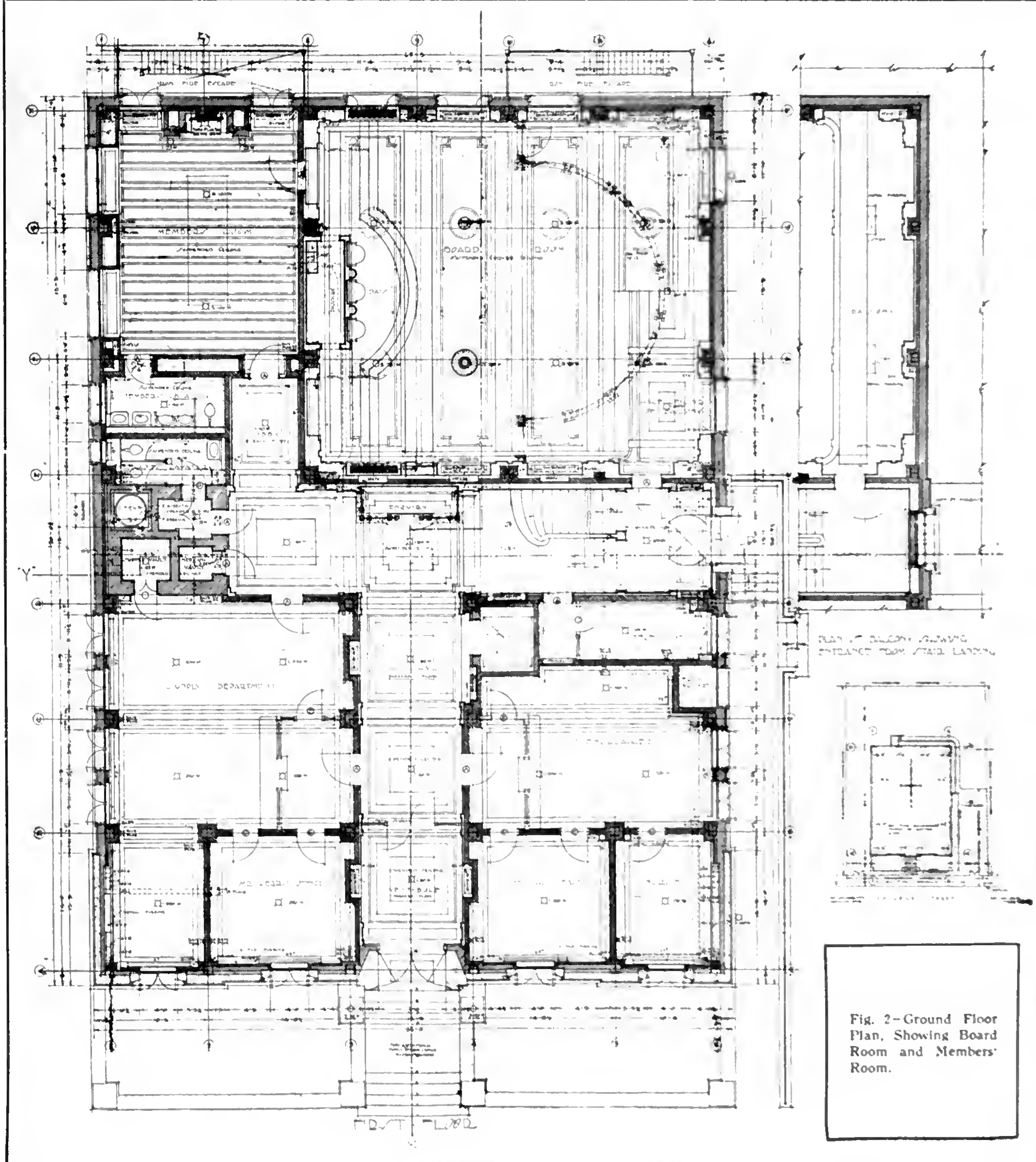


Fig. 2—Ground Floor Plan, Showing Board Room and Members' Room.

On the right and left of the entrance are situated the medical inspection and supply departments.

The members room is approached through an ornamental doorway on the left of the enquiry wicket. This room is designed as a comfortable meeting place for the members, being finished with panelling with stucco frieze over and a heavy beamed ceiling.

The lockers and telephone booths for the members are arranged in the wall panelling with special toilet accommodation directly off this room.

The special feature of this room is the large open brick fire place, over the shelf of which is a marble panel with bas relief carving symbolical of Education. The woodwork finish of the walls, ceiling and furniture will be of walnut.

A private entrance opens from the Members room into the Board room. The Board room is Italian Renaissance in design, the walls being treated with twin fluted pilasters of the Corinthian Order surmounted by an enriched Entablature with panelled frieze and supporting an ornamental segmental ceiling.

The focal point in this room is the Walnut Dais which is raised upon a platform. The desks and seats for the Members of the Board are arranged in horse shoe form, the space in the centre being occupied by tables for secretary and the press.

Ample provision for the public is arranged on the main floor and also in the gallery which is accessible from the main stair landings. These doorways are adjacent to the side entrance of the building.

The gallery is supported on the cantilever system so as not to obstruct the view with columns.

The general finish of the furniture and wood trim will be walnut.

The second floor is given up to two Committee rooms and the Secretary-Treasurer's Department, while the third floor is occupied by the Inspector's department, with ample accommodation for a private office for the Chief Inspector, and desk rooms and an

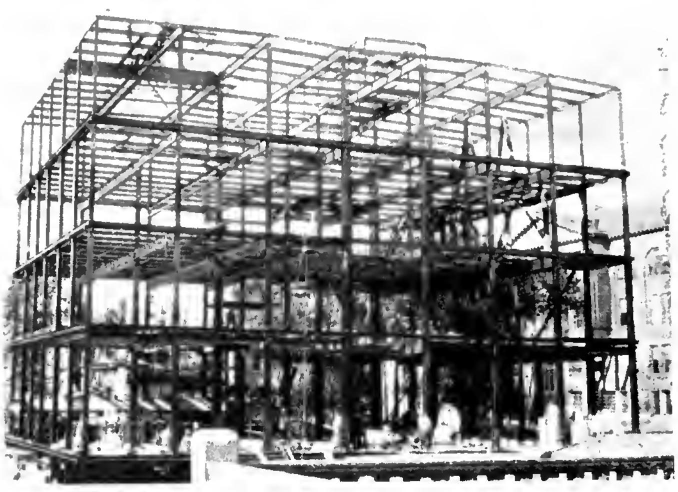


Fig. 3.—Steel Erection—Administration Building, Oct. 21, 1915

inspection room for the Junior Inspectors. The library is also here, and a room for supervising teachers. Use is also made of one room on this flat for a contractors' office in connection with the building department, which will wholly occupy the next floor, with suitable rooms for the various needs of the work. Special care has been given to the draughting room in providing ample light by installing skylights in addition to the windows.

The basement is given over to the heating and ventilating apparatus, fuel storage, caretaker's apartments, and kitchen and lunch rooms for the staff.

A special feature of the building is the fireproof vault, which is built on a separate foundation and is

Fig. 4.—Administration Building, Toronto. Erection Progress Jan. 6.

entirely independent from the skeleton construction of the building. Other notable aspects are the modern sanitary lavatories on the different floors, and the special ventilation system in the Board room, Members room and Committee rooms. Steam heating and fan ventilation are used throughout. An electric elevator will provide accommodation to all floors.

The building, which will cost about $140,000.00 inclusive of the interior finishings, was erected under the supervision of the department by the following constructors:—Masonry, H. N. Dancy & Son; Steel, Dom. Bridge Co.; Fireproof floors, J. A. Wickett, Ltd.; Roofing, W. E. Dillon Co. Ltd.; Carpenter, F. Armstrong; Painter, F. A. Ovens; Plasterer, A. D. Grant; Wiring, A. R. Rice & Co.; Plumbing & Heating, John Ritchie P. & H. Co. Ltd.; Iron work, Can. Orn. Iron Works; Heat control, Johnson Temp. Reg. Co.; Marble & Terrazzo, Can. Glass.

Metal for Shells

Specifications for Russian 3-inch shells call for a loading of 258 to 260 half-inch bullets, consisting of 4 parts lead and one of antimony. This requires practically 4.908 lb. lead and 1.217 lb. antimony per shell. In addition, fine stibnite mixed with magnesium powder is used to produce the smoke that enables an observer to register the point at which the shrapnel bursts. This calls for 0.0238 lb. stibnite and 0.02322 lb. magnesium per shell. British 3.3 inch shrapnel uses even more lead, the total weight of the bullets being 7.92 lb. and the composition 7 parts lead to one of antimony. This shell also requires 4.04 lb. copper and 1.87 lb. spelter.

The London Concrete Machinery Company have secured the contract from the Imperial Oil Company to supply two 21-cu. ft. batch mixers with gasoline power. Both mixers are to be used in the erection of the concrete work on the Imperial Oil Company's new plant at Pointe Aux Trembles, Que.

Methods and Costs of Garbage Disposal

Different Systems of Final Disposal Employed by U. S. Cities—Incineration and Reduction — By-Products — Methods of Financing Cost

(Concluded)

The following are some of the reports from cities which receive a revenue from by-products:

Minneapolis.—The steam generated lights and heats hospital and workhouse buildings, also lights 31 miles of streets. Estimated annual revenue, heat, $6,293.89; light, $1,080.62; street lights ($60 per arc), $4,657.48; total, $12,031.99.

Borough of Richmond.—West New Brighton incinerator uses clinker in manufacture of brick by mixing cement with ground clinker.

New Orleans.—Plans perfected to light streets and public buildings. Claimed that from 500 tons of garbage daily, 30,000,000 kw. can be generated a year.

Savannah.—Ninety-five per cent. of coal fuel previously used at pumping station is now saved by destructor. To operate waterworks pumping station it cost $81.90 per day. To operate the station and destructor it costs $46.50 per day, or a difference of $12,921 per year, this being 10 per cent. of the cost of the plant. This is expected to provide for repairs and amortization charges. Besides, the city has all of its refuse disposed of without cost at a central point and in a sanitary manner with freedom from nuisance. The clinker is used for road building and is estimated to have a value equal to the cost of hauling it from the plant.

All reports and experts agree that destructors are very successful from a sanitary standpoint and have the advantage over other methods in that the different classes of waste can be destroyed by one process and gathered in one collection. Several also agree that the destructors when properly constructed and operated, may be centrally located, thus reducing the cost of haul. Another point mentioned is that there is some revenue. The disadvantages pointed out by experts are that, if not properly designed and operated, there will be dust and odors, all refuse must be hauled to the plant and expert workmen must be employed.

The cost of operation varies from city to city, and in each city from month to month, depending upon the season of the year, composition of the garbage and climate. Most incinerator companies guarantee to operate their furnaces at full capacity at about 50 cents per ton. Milwaukee operates for about 57 cents per ton. The cost, including maintenance, depreciation and fixed charges, and operating expenses, averages from $1.50 to $2.50 and sometimes $3.00 per ton. The State Board of Health of Ohio found in its investigation that incineration cost from $1.97 to $2.50 in Canton, Ohio; $2.00 to $2.66 in Marion; $1.00 to $1.84 in Steubenville, and $2.58 in Zanesville, during a period of several years. These figures include interest, depreciation, maintenance and repair charges.

J. W. Turrentine, of the U. S. Department of Agriculture, who has just completed a study of garbage disposal plants, says in a recent bulletin that the average net cost of incineration per ton as obtained in a number of instances, is $2.11 per ton, and that in one of the cities considered there is a credit for power generated of 22 cents per ton of garbage incinerated.

Venable says, "the operating expenses are in the neighborhood of 50 cents per ton of kitchen garbage destroyed. The maintenance is from nothing to $1.00 per ton, according to the design and material employed, and the degree is from 10 per cent. to 50 per cent. per annum. In some furnaces a less cost of operation is claimed, but the claim of each builder should be subject to a careful investigation before being accepted as justifiable. The maintenance and depreciation charges are large in all crematories, but they depend to a great extent upon the character of the workmanship, and the quality of material used, as well as the designs. A poorly constructed crematory, even if of meritorious design, will not last a year, while a well constructed one of good design should last ten years or more with occasional replacement of worn parts."

Life of Plant

Most garbage incinerator manufacturers claim a life of twenty years for their plants with reasonable renewals.

Morse claims that when fuel is necessary the cost of destroying refuse and garbage in crematories is approximately 50 cents per ton. He also says that the cost of operating destructors is from 50 cents to 70 cents per ton for actual labor expenses, while the cost of operating the modern high-temperature destructor will not exceed from 50 cents to 60 cents per ton. Deducting credit for power, the cost will drop, he says, to 30 cents or less per ton. Depreciation and capital expenses are not included in Morse's calculations.

Greeley asserts that the cost of operation will range from about $1.00 to $1.50 per ton, "but local conditions may alter these limits."

C. O. Bartlett says: "So far as disposal of garbage is concerned, in incinerators, it is coming to be generally understood that this method is far from sanitary and is essentially wrong in that it neglects to obtain the value for the products so collected."

Rudolph Hering says: "In incineration, if sufficient fuel is added, the combustion can be made perfect and the garbage can be destroyed without offense and converted into unodorous gases, ashes and clinker. Whatever sanitary objection has been made to this process has resulted from preventable causes. Unless ashes and rubbish are combined with garbage in sufficient quantities to produce the necessary heat, the steam production is deficient and other fuel must be added."

Robert H. Wylde says of incineration at a high temperature: "Here we have a method that is at once sanitary, expeditious and economical in first cost and maintenance." He also points out that this method is free from nuisance, the plant may be centrally located, cost of collection minimized owing to the relative shortness of hauls, not necessary to maintain a separate collection, nor is there any necessity to keep refuse in separate cans.

W. F. Goodrich maintains that modern destructors are perfectly satisfactory and that there may be no fear of nuisance wherever they are located. He maintains that it should be the aim of officials to utilize the power produced for the best interests of the community.

William M. Venable says that cities of from 10,000 to 40,000 population should burn garbage and refuse, the problem to be solved being the advisability of attempting to utilize the heat generated by burning.

Reduction

When this method is used only garbage and dead animals can be destroyed, but when these kinds of wastes are broken down by means of heat, valuable by-products are recovered. This may be done in two ways, the processes being known as cooking and drying. In the first, garbage is cooked in large closed retorts by means of steam under pressure. It is then pressed, leaving grease and a dry cake known as tankage, which is used for fertilizer. In the drying method the grease is extracted by some volatile solvent like naphtha. The relative advantages of these two methods is disputed. At the present time the majority of plants are operated by the cooking method. C. O. Bartlett says that the cooking method does not permit of the recovery of any considerable portion of grease, but does provide for the retaining of most of the solids in dry form, after which they may be ground up to serve as a base for fertilizers. He also says it is open to some objection on account of escaping gases from the stack unless there are sufficient scrubbers.

Irwin S. Osborn sums up as follows the advantages and disadvantages of each process:

Drying Process

Advantages.—Cost of plant is less, due to equipment and building space required; the operating costs are less, due to amount of labor and power required.

Disadvantages.—Carbonizing of the grease in the dryer, due to high temperature required, so that the maximum amount of grease is not recovered; the material is not broken down so that solvent will act as readily on grease particles to allow maximum recovery; the mechanical condition of by-products is not as desirable without additional treatment; there is a greater volume of gases to be deodorized.

Cooking Process

Advantages.—The cells of the material are more completely broken down so that a larger amount of grease can be more readily recovered; all material is enclosed during the process so that the gases are more readily deodorized with less volume to be deodorized; in the modern plants the mechanical condition of the by-products is better.

Disadvantages.—Increased fixed cost of building and equipment; increased operating cost; increased maintenance cost.

He says that by-products produced by either have the same relative market value. In plants that have been operated by both methods, the experience has been that the additional amount of grease recovered by the cooking method has more than offset the increased costs and at the same time the odors were eliminated to a larger extent.

In establishing a reduction plant, Rudolph Herring says that the great fear is creating a nuisance. He further says that, owing to unpleasant odors apt to arise at the works, it is necessary to have good ventilation and also a subsequent treatment of some of the vapors and liquids which result from the process. These contingencies make it advisable, he believes, to locate the plant in a neighborhood where the possibility of occasional unpleasant odors will not materially injure value of adjoining property.

The Chicago Waste Commission contains this suggestion as a solution of the odor problem: "In addition to the steam and electrical power that can be furnished from a destructor plant to operate a reduction plant, the exhausting of all gases carrying odors from the reduction works and passing them through the destructor would prove one of the greatest advantages from a sanitary and economical standpoint to be derived from a combined method of disposal of all municipal wastes."

Osborn says: "Economical results may be obtained by utilization of heat in the disposal of garbage mixed with other refuse, by burning, but to prove satisfactory the maximum sanitary results must be obtained at a minimum cost, and when the quantity is such that it will warrant utilization the reduction method will continue to show more economical results, and with proper attention given to details and sanitary features the work can be conducted without nuisance."

Reduction is a method which can be adopted only by large cities. It seems to be usually agreed that cities with less than 100,000 population and producing less than 75 tons of garbage daily will find the reduction process will not pay as a business venture. One writer says in no place of less than 150,000 population can these kinds of plants be operated successfully. Venable places the minimum population at 100,000. He says that as approximately 80 per cent. to 90 per cent. of kitchen garbage is water and only 10 to 20 per cent. is composed of grease and other substances it takes a large amount of garbage to make a reduction plant profitable.

Parsons fixed the minimum population at 200,000. He points out in his book on "The Disposal of Municipal Refuse" the following advantages and disadvantages of the method:

Advantages.—The organic or putrescible matter of the garbage is extracted into compounds which are harmless,—grease and tankage; it thus saves those components which have a material intrinsic value; the garbage is cared for in a sanitary manner; the cost is about $1.80 to $2.00 per ton to the city and no revenue from the grease and tankage; as the works are situated some distance from the city the haulage is only on the garbage; when properly designed and carefully operated, the process need not be a nuisance, and its adoption adds a new manufacturing industry.

Disadvantages.—The first cost is high; expensive machinery and apparatus are required; the cost of renewals and repairs is large; the odors and smells are apt to be given off and the expense to prevent such an annoyance; the distant location of the plant from the city in order that odors may be least objectionable; being a manufacturing plant it should be erected and operated by private interests; being operated for profit there is danger that the works may become a nuisance; requiring skilled labor, there is some danger of strikes; the garbage must be separately collected; there will always be some foreign material, tin cans and the like, which must be sorted out at the works; there being but one plant the system would be crippled by fire or by any cause stopping the plant; the plant cannot be divided, as small plants do not pay; the process cares for the garbage only, leaving the remaining refuse to be otherwise treated.

Cost of Reduction

The cost of a reduction plant will range from $1,500 to $3,000 per ton of daily capacity, according to published reports.

The gross cost of garbage destruction by the reduction method varies from $1.50 to $2.50 per ton of raw garbage. In only a few instances does the sale of the by-products meet or exceed expenses. In a majority of cases, the process is carried on by private companies, the most being subsidized by cities to amounts varying from 50 cents to $2.50 per ton. A few companies pay the city for all garbage delivered to the plant.

The by-products of the reduction method are grease and tankage. It is generally agreed that ordinary garbage contains from 2 to 3 per cent. by weight of grease and must yield from 200 to 400 lbs. of tankage per ton.

J. W. Turrentine says that on the basis of figures obtained in the operation of a number of reduction plants, it is shown that the average cost of reduction is $2.41 per ton, and the gross receipts $3.30 per ton, giving a profit of 89 cents per ton raw garbage. He asserts that when consideration of cost of collection is excluded, the rendering of garbage is distinctly more profitable than incineration.

Cleveland and Columbus have been the cities most successful in operating reduction plants. In 1914 the Columbus plant received 21,628.97 tons of garbage, or 211 lbs. of garbage per capita. From this and the 183 large dead animals received, the actual production was as follows: Grease, 1,186,985 lbs.; tankage, 1,753 tons, hides, 183. The value of these by-products were: Grease, $52,672.21; tankage, $12,987.84; hides, $1,062.30, or a total of $66,772.35.

Each ton of garbage produced 54.87 lbs. of grease and 162.1 pounds of tankage. The grease value per ton of garbage was $2,435; the tankage, 60 cents, and the hides, 5 cents, or a total of $3.085 per ton of garbage. The actual cost of operation was $40,220.78, or $1.859 per ton. The net profits were $26,501.57, or $1.226 per ton of garbage.

Cleveland, in 1912, produced 2,940,000 lbs. of grease and 10,016,000 lbs. of tankage, the city receiving for them $151,162.48. This reduction cost per ton of green garbage was $1.97½, and the earnings per ton of green garbage was $3.47, making the net earnings per ton of garbage, $1.49½.

New York City sells its garbage to a private company. It made a contract for 1914 to 1916, inclusive, and the right to renew the contract for two more years on the same terms and conditions. The city receives at the rate of $62,500 for the first, $87,500 for the second, and $112,500 for the third and each of the succeeding two years.

The Practical Selection of Aggregates for Concrete Construction*

It is not the intention of this article to deal with the hardness, angularity, roughness, roundness, or general fitness of any given aggregate. The aggregates are supposed to be clean and of such quality that the work at hand can be performed by properly combining them to get the desired result. The article is also based on the assumption that the reader has an intimate knowledge of the proper degree of wetness or dryness necessary to attain the best results; also that the dangers of inefficient mixing and placing of concrete will at times cause disastrous results, no matter how good the materials.

Sand

It would not be amiss to state that the best sand (or stone) is that which has grains of all sizes present, such that the smaller grains fill the voids of the larger, the percentage of any particular size being only sufficient to fill the voids between the grains of the next larger. Sand is generally considered to be the finer aggregate, having grains ¼-in. diameter or less. Moist sand occupies more space and has more voids than dry or saturated sand, this difference ranges from 5 per cent. to 10 per cent., and is entirely dependent on amount of moisture. The maximum size of sand grains can only be determined by the size and graduation of the large aggregate. The larger the aggregate, the larger the sand (the coarser sand). When we combine small gravel or stone 1 in., ¾ in. or less, with coarse sand ¼ in. to 1-20 in., we get concrete, "that's all." When we combine 1 in., ¾ in., etc., aggregate with fine sand graded through all sizes (⅛ in. max. size) down to the finest, we get maximum strength and maximum density. The smaller the coarse aggregate the smaller the sand grain.

The best sand for 2½-in. stone varies from 1/3 to 0.-3 meshes per lin. inch.

The best sand for 1½-in. stone varies from 1/5 in. to 0.-5 meshes per lin. inch.

The best sand for 1-in. stone varies from 1/6 in. to 0.-6 meshes per lin. inch.

The best sand for ¾-in. stone varies from 1/10 in. to 0.-10 meshes per lin. inch.

The best sand for ½-in. stone varies from 1/14 in. to 0.-14 meshes per lin. inch.

This can readily be established by trial. These sand sizes mixed with graded stone of above-mentioned sizes will give least volume, maximum density, greatest weight per cubic foot. After you have once established this fact, use all the cement necessary to attain the required strength. Sand cement tensile tests are not a true index to the compressive strength of concrete, unless we grade the sand to the size necessary to give maximum density for the coarse aggregate to be used.

Large Aggregate

Now take up the large aggregate, which we will consider as gravel. The same distinguishing line will have to be drawn as to what constitutes gravel.

2-in. to 1/4-in. graded gravel has an average of 33 per cent. voids.

1½-in. to 1/5-in. graded gravel has an average of 35 per cent. voids.

1-in. to 1/6-in. graded gravel has an average of 37 per cent. voids.

¾-in. to 1/10-in. graded gravel has an average of 40 per cent. voids.

½-in. to 1/14-in. graded gravel has an average of 45 per cent. voids.

You cannot combine small gravel 1 in. or less with sand, no matter how you grade it and get so few voids, so heavy a mixture, so dense a mass, as when you use the larger size gravel. The reason for this is you cannot get the proper graduation of sizes, and on account

* By R. J. Borhek in Engineering & Contracting.

of the displacement of the finer particles due to the large sizes of gravel. For maximum density your proportion would be for the different sized stone, considering sand 1/4 in. and under—

2-in. stone graded to 1/4-in., 33 per cent. sand.
1 1/2-in. stone graded to 1/4-in., 38 per cent. sand.
1-in. stone graded to 1/4-in., 47 per cent. sand.
3/4-in. stone graded to 1/4-in., 54 per cent. sand.
1/2-in. stone graded to 1/4-in., 66 per cent. sand.

Use of Coarse Sand

One very common failing is when small gravel or stone is used the sand is too coarse or else not enough of it is used. The voidage in fine gravel or stone, even though the grading be scientifically correct, cannot possibly be as low as when a large graded aggregate is used.

The reason for the denser and harder concrete is this: The coarse particles having a larger volume displace a large proportion of the fine, thus affording an excess of mortar.

We might illustrate this by comparing the volumes and surface areas of particles of different sizes and diameter. The argument will at once be brought forth that the gravel particles are not perfect spheres. That is true enough, but consider also that a 2-in. diameter sphere is equal in volume to two ellipsoids having a 2-in. long axis by 1-in. short axis. Choose any other figures approximately the shape of a particle of gravel, spherical sector, segment or zone, measure up the actual surface area by forming a plastic mould around same, planimeter the area and you will conclude that the average gravel particle passing through a given screen approximates a sphere in volume and surface area. Now, with this assumption proceed as follows:

In volume 1 particle 2 in. in diameter equals 8 particles 1 in. in diameter. In surface area 1 particle 2 in. in diameter contains one-half the surface area as the 8 particles 1 in. in diameter. Theoretically it would require but one-half the amount of mortar to cover the 2-in. particle as it would to cover an equal volume of 1-in. particles. In practice this is not quite true because of the voids in the volumes of smaller particles, and also because the particles are not perfect spheres.

Mortar Required

By actual practice and a measurement of densities of a mass of sand and gravel it is absolutely established that the volume of 1-in. particles cited in the above case will require 1 1/2 times more mortar than the volume of 2-in.

For a comparison: determined by actual measurement:—

1 cu. ft. 1 1/2-in. gravel has 1.15 times the surface or contact area of 1 cu. ft. 2 in.

1 cu. ft. 1-in. gravel has 1.3 times the surface or contact area of 1 cu. ft. 2 in.

1 cu. ft. 3/4-in. gravel has 1.75 times the surface or contact area of 1 cu. ft. 2 in.

1 cu. ft. 1/2-in. gravel has 2.00 times the surface or contact area of 1 cu. ft. 2 in.

One reason for the excess of mortar required is plainly seen. One reason for the more cement required is established. The advantage gained by using the largest aggregate possible for reinforced concrete work is very evident. You have less surface contact, more bond adhesion, and stronger concrete.

The arguments brought against the use of the larger aggregates will be: honeycombing and pocketing, can't be done. The objection can be dismissed on the ground that in intelligently mixed and placed concrete, pocketing and honeycombing do not occur.

Two-inch aggregates can be used in 12-in. columns and 8-in. beam, the large gravel is merely displaced by the finer gravel and mortar, and when properly agitated will always flow into place. What do you care whether you have 2-in. aggregate in the core of a 12-in. hooped column or whether the finer material flows to the outside to act as a protective coating? Concretes richest in cement are least permeable. Measure the permeability of neat cement. Measure the permeability of 1 to 1 mortar. Measure the permeability of 1 to 2 mortar. The 1 to 2 mortar is about 100 per cent. more impermeable than the neat cement and about 50 per cent. more impermeable than the 1 to 1 mortar.

Permeability of Mortar

Measure the permeability of neat cement, of 1-1-1 concrete, and of 1-2-5 concrete. The 1-2-5 concrete is 100 per cent. more impermeable than the neat cement and about 40 per cent. more impermeable than the 1-1-1 concrete. The permeability of concrete is much influenced by grading of aggregate, particularly the sand. Using the same gravel and sand a 1-2-7 concrete is more impermeable than a 1-2-4, and this can be demonstrated, even with a poorly graded and fine sand.

In considering mortar—mortar to be permeable should contain a large percentage of fine sand, sand below No. 50 and nothing above No. 20. A coarse sand mortar is not nearly so impermeable as a fine sand mortar. Crushing gravel does not add to the strength of the concrete. Crushing merely increases the voidage due to the angularity of particles. Tests in crushed gravel 1 1/2 in. to 1/4 in. showed an increase of voidage for 35 per cent. natural material to 42 per cent. for crushed.

Graded crushed stone weighs less than graded natural gravel, the specific gravity being the same. Why? More voids. The particles of crushed stone are more nearly cubical than the gravel—more surface area (more contact area)—more voids.

Crushed limestone 1 1/4-in. to 1/20-in. voids 37 per cent. weight 98 lbs. per cu. ft.

Crushed granite 1 1/4-in. to 1/20-in. voids 41 per cent. weight 95.3 lbs. per cu. ft.

Screened gravel 1 1/4-in. to 1/10-in. voids 33 per cent. weight 102.4 lbs. per cu. ft.

Crushed limestone 1-in. to 1/4-in. voids 45 per cent. weight 85 lbs. per cu. ft.

Adhesion

A roughened and pitted gravel has the same adhesion for cement as that of crushed stone. Some river gravels on account of the smoothness, particularly quartsite pebbles, which are not only smooth, but hard to wash free of slimy accumulation, are not as good as crushed stone of the same hardness. The advantage of using gravel over broken stone is that gravel concrete works smoother (flows easier) and is more dense.

The writer would suggest that in analyzing sand for concrete purposes, sieves of 4 mesh, 14 mesh and 40 mesh be used, 100 per cent. to pass No. 4, not more than 70 per cent. to pass No. 14, not more than 30 per cent. to pass No. 40; this would assure a grading having enough sizes present to give an excellent mortar.

The Mainland Engineering Company, Limited, has been incorporated with head office in Vancouver and a capital of $50,000.

Gothic Church Work in Toronto

By Walter J. Allen, R.S.A.

Among the many and varied branches of wood work practised in this country none have suffered from an ignorance of its technique as has Gothic work.

One would have thought that a craft which has been eulogized for ages by all sorts and conditions of men—antiquaries, historians, architects, philosophers, scientists, travellers, etc—would have reached, in some sense, the exalted plane it rightly occupies in all civilized countries of the world.

Our neighbors across the line have long gained the pseudonym of "globe-trotters"; but the result of this "trotting" around the ancient cathedral churches of the Continent and Britain is reflected in some of the fairly magnificent churches of the United States—notably, perhaps, in the cathedral church of St. John, New York.

There are not wanting signs that Canada is slowly awakening to the peculiar richness and beauty of the true Gothic style. This is shown by the accompanying illustration, which, though small, sufficiently conveys the idea referred to. It is known as a "reredos," and was constructed by L. Rawlinson, Limited, for St. Simon's Church, Toronto. It is in the "Decorated Style" (or 13th-14th Century work). The three subject panels are surmounted by pierced canopy work, which finishes with a cap mould, the chief member of which is pierced enrichment, and finally the cresting, also pierced, and carries the dedicatory "Sanctus."

It is often asked, "Why do you pierce the tracery?" "Do you always cut it through?" etc. The answer is: All the finest examples of medieval work are so treated; the reason being that the "hallowed twilight"

Fig. 1 Reredos, St. Simon's Church, Toronto. A beautiful example of church woodwork

prevailing in the interiors of most of the old cathedrals and churches necessitated such treatment, if the richness of line and beauty of contour were not to be lost in the sacred gloom. In any case, however, whether interiors are dim or coldly light, the beauty of the work is much enhanced by a free use of the "open work" wherever possible. This will be especially noticeable in the general effect.

Exquisite examples of this pierced, or open, work in wood and stone were to be seen in the never-to-be-forgotten cathedral churches of Louvain, Lille, Rheims, etc. There are, of course, other fine examples still extant, some of which show the advantage of this particular treatment in other directions—as, for instance, the magnificent reredos, forty-six feet high, built in front of an equally magnificent stained glass window, each lending to the other a charm more easily imagined than described. This open worked reredos is in English oak, and cost £1,600. It is in St. Alban's Cathedral, Hertford.

Fig. 2 shows one of the two "wings," or sides, to the reredos shown in Fig. 1. These connect the reredos with the north and south walls, respectively. They are necessarily less elaborate than the centre

Fig. 2.—Side view of one wing of Reredos.

piece, or reredos proper, yet are in strict harmony therewith. The angels carry forward the idea expressed in the centre panel, Gloria in Excelsis.

This and a few other examples were wholly executed in Toronto.

The Sovereign Lime Company, Limited, has been incorporated, with a capital stock of $50,000, to carry on business as manufacturers of and dealers in lime, terra-cotta, brick, cement, mortar, concrete, asphalt, marl, tiles, drain and sewer pipes, stone and artificial stone, etc The head office of the company is in Montreal.

A Mixer for the Small Contractor

The London Concrete Machinery Company, Limited, London, Ont., have brought out the "Handy Mixer" suitable for the brick contractor, the plastering contractor, or for the smaller jobs in concrete work. It is claimed that in any job requiring less than 40 cubic yards of material per day this kind of mixer will prove an economy. There is no need of hauling a large mixer around for these small jobs,

while at the same time the expensive hand mixing method is done away with. The low cost of moving and operation make this mixer a valuable part of the equipment of all small jobs. The mix turned out by this machine is claimed to be equal to that of the large-size machines and, of course, vastly superior to hand work. One man can mix as much mortar with the "Handy" mixer as four men can by hand. In addition, it is claimed that around 25 per cent. of the lime or cement is saved. The illustration herewith shows a side view. The machine is operated by a 2 h. p. gasoline engine.

The Turbine Equipment Co. recently secured a contract from the Imperial Oil Company, Limited, for their new refinery at Montreal, for ten De Laval steam turbine-driven centrifugal pumps; also a contract from the Standard Chemical, Iron and Lumber Company for a one and a half million gallon De Laval motor-driven centrifugal pump.

There are now employed a number of processes whereby wood can be so altered in character that it becomes almost fire-proof, and is no longer liable to dry-rot or any of the disintegrations that come under the head of decay.

Under what is probably the best method, the wood, after having its sap extracted by air-suction in a closed vessel, is charged with a solution of metallic salts, the entire treatment occupying about four hours. It is said that green wood thus treated neither shrinks nor warps, thus obviating the seasoning generally necessary, and that soft woods become so hardened that they can be utilized for purposes for which they were quite unsuited in their original condition, and become almost incombustible and capable of receiving a high polish.

Barn Building Catalogue

Beatty Brothers, Limited, Fergus, Ont., are distributing a very attractive catalogue, called Book No. 26, covering barn construction and equipment. The book is splendidly illustrated with barns (exterior and interior) and various equipment as installed at many points in Canada by this company, and including such well-known names as Colonel Robertson, Williamstown, Ont.; Gordon Gooderham, Clarkson, Ont.; William Innes, Headingly, Man.; C. P. R. barn, Strath-

Col. Robertson's barn at Williamstown.

more, Alta.; Ottawa Dairy Company, Ottawa, Ont.; Robert Kelly, Vancouver, B.C.; James Dunsmuir, Victoria, B.C.; and many others. The illustration shows the fine barn recently erected and equipped by Beatty Brothers for Colonel Robertson.

Montreal's Asphalt Contracts

Last year the city of Montreal had considerable trouble over its supply of asphalt; legal proceedings followed the award of contracts, and for a time the city was tied up in the matter of completing its road programme. It was expected that this year the bids would be on a higher scale, and when the tenders for about 6,000 tons were opened it was found that about $5 a ton above last year's quotations was asked. The tenders received were: Warner-Quinlan Company, $19.33 per ton; Elder Ebano, $21.98, delivered at the north end yards, $23.23 delivered at the eastern yards, and $22.43 delivered at the Grand Trunk station; United States Asphalt Refining Company, $22.73; Sicily Asphalt, $26.40 for the Trinidad grade, and $32.40 for the Bermuda grade. The Board of Control referred the bids to the engineers' and law departments, and also asked that the samples be analyzed. The Imperial Oil Company wrote the Controllers asking that the city buy only quantities needed for immediate use, as the company intended to complete in August next a large asphalt refining plant at Pointe-aux-Trembles, and would then be in a position to supply the city.

Famous Picture Ads.

Word has just come from New York, which would indicate that a decided compliment has been paid to the Dunlop Tire & Rubber Goods Co. A large agency who keep a portfolio of the world's best advertising matter gathered together from every part of the map include in that portfolio the Dunlop "Famous Picture" series which appeared in Canadian newspapers last September. The "Famous Pictures" were the first ads. of the type ever run in America, or any other part of the world so far as can be traced, and that is probably the reason why the agency in question selected the series for their portfolio, as their big endeavor is to get new treatment on any subject or, in other words, originality all along the line.

Grouting at 700 lbs. Pressure

Grouting is now an established method of stopping flows of water in shafts, adits, and drifts. A mixture of cement and water, say a bag of cement to three 12-qt. pails of water, with sometimes a little sand, is forced by a grout-machine into holes drilled in the rock, the pressure being furnished by compressed air. Pressure of 100 to 200 lb. above the hydrostatic head is used in difficult shaft problems. The Nova Scotia Steel & Coal Co., in its iron mine at Bell Island, Newfoundland, where the mine workings are several miles out under the ocean, has a grout-car run on wheels that can force grout into rock at pressures as high as 700 lb. per square inch. By use of this grout-car the workings, although under the Atlantic ocean, are kept fairly free from large flows of water.

Fireless Steam Engine

A fireless steam locomotive is used for switching cars and tie trams at an Ohio creosoting plant. The locomotive is of a type which was developed in Europe some years ago and is used around distillation plants, where cinders and live ashes would constitute a fire danger. This locomotive operates by steam, the boiler being charged about seven times every twenty-four hours at the main boiler, at 150 lb. pressure. The maintenance cost of this type of switching engine is very low, and its use is said to be very satisfactory in a treating-plant yard. Its tractive power is fully equal to that of the usual type, and although it weighs only 22 tons it has pulled as many as twelve loaded gondola cars at a time. Perhaps there are construction contracts on which a locomotive of this type would be an economy.

Hamilton Gets Another Factory

The Ontario Yarn Co., Markham, have leased a building on Stuart Street, West, Hamilton, for a branch factory to manufacture knitting and hosiery yarns. About 25 or 30 hands will be employed and the plant will run 24 hours per day. Carding, spinning and winding machinery is being installed now and they expect to start operations by the first part of April.

Mr. H. P. Borden, Member of Commission

Mr. H. P. Borden, C. E., has been appointed a member of the Government commission which has charge of the construction of the new Quebec Bridge. This appointment is to fill the vacancy left by Mr. C. C. Schneider, of Philadelphia, deceased. Mr. Borden is well-known to the engineering profession, as he has been connected with the board since its inception, the last few years as assistant to the chief engineer.

The Canadian Facts Publishing Company, 588 Huron Street, Toronto, have just issued their 1916 edition of "Five Thousand Facts About Canada," compiled by Mr. Frank Yeigh, of Toronto.

Street Railway Track Construction

Development of Modern Methods of Laying Car Tracks—Concrete Base the Only Permanent Form

By R. Keith Compton*

Importance of Construction.—One of the most difficult problems which a municipal engineer faces in street improvement of today is the premanency of the street railway track construction. On this point hinges the durability and integrity of that portion of the pavement immediately in the railway area and adjacent thereto. Even in outlying suburban sections, pavements on streets where railway tracks exist are more difficult to construct and maintain than on streets where no tracks exist. The situation is intensified when similar streets are to be improved in heavy traffic sections of busy cities.

Early History.—The speaker takes the liberty of introducing into this subject his experience in the City of Baltimore, where this matter has been given most careful attention, both by the municipal authorities and the street railway officials. In collecting data on this subject from the principal cities of this country we find that other cities have passed through similar experiences. Some fifteen years ago it was the practice of street railway companies to lay the ties directly on the original earth foundation of the street, tamping up with whatever local material was convenient. Consequently track structures had absolutely no stability other than that given by the natural earth foundation existing in the street, so that within a few months after the street was improved and opened to traffic the rails would vibrate under the movement of cars and heavy trucks, with the result that cracks would develop in the paving adjacent to and for several feet on either side of the rails, causing rapid disintegration of the paving, particularly in the case of sheet asphalt. If the pavement were of stone or vitrified block, cracks would develop and the paving blocks would soon begin to "work" and loosen up. Within twelve months the paving in the railway area would be in such condition as to seriously impair the usefulness of the street. This disintegration did not confine itself to the railway area, but would gradually encroach upon the city area.

The next development in this construction was the installation of gravel ballast. This was somewhat of an improvement over the original construction, the only difference being that the development of cracks and disintegration was somewhat postponed. Gravel, being round and smooth, would shift under the strain of passing traffic, with results most damaging to the paving.

The crushed stone ballast was then used. On suburban streets with light car and vehicular traffic this was a decided improvement, and in some instances the results obtained, both as to track construction and maintenance of paving, were most desirable. Care, however, had to be taken by the track gangs to see that most careful tamping was done. The rock ballast construction, however, in heavy traffic downtown streets, did not give the results desired, so that in the past few years many cities have been installing a concrete slab, from 6 to 8 ins. in depth, under the ties, then brought up and completely enveloping the ties in concrete, and the concrete foundation for the paving installed on top of this.

Right here it may be well to note the following list of cities which have used or are using concrete as a foundation for track construction, in whole or in part. Most municipalities do not use it exclusively, but use concrete in the heavy traffic sections, and rock ballast in the suburban sections where car and vehicular traffic is light, or where the paving of streets may not be regarded as permanent on account of the surrounding property being undeveloped. This information was obtained in 1913 and 1914 through correspondence with municipal officials in the respective cities. These cities are as follows: New Orleans, La., Chicago, Ill., Buffalo, N. Y., St. Louis, Mo., Norfolk, Va., Boston, Mass., Detroit, Mich., New York (Brooklyn), Cleveland, O., Nashville, Tenn., Memphis, Tenn., Springfield, Mo., Birmingham, Ala., Dayton, O., Cincinnati, O., Baltimore, Md.

It is a fact that traction engineers as a rule object to concrete under the ties, claiming three distinct disadvantages:

Objections of Traction Officials.—First, that concrete under the ties makes the track construction entirely too rigid, and that rock ballast gives equally good results and overcomes this rigidity in that it allows a certain amount of resiliency, and that such resiliency is necessary, otherwise undue wear will take place on the rails from passing cars, and that rigid track construction is hard on the equipment.

Second, that in case of reconstruction the railway company is put to an unnecessary expense removing the concrete so as to replace defective or disintegrated ties with new ones.

Statistics show that there is no real ground for the first objection, and even if there were, this can be overcome by keeping the concerte base an inch or so low and bedding the ties in a thin bed of loamy sand on top of the concrete slab. Care should be taken, however, to bring the concrete up on the ends of the ties so as to confine the sand and prevent its shifting.

Replacing Ties

The second objection can be overruled by the fact that in replacing worn-out or disintegrated ties, the railway company does not have to remove any more concrete than it would otherwise remove were the pavement only on a concrete foundation of the usual thickness, as will be hereafter shown by the method of construction followed by the City of Baltimore. Furthermore, statistics compiled by the Board of Supervising Engineers in the City of Chicago, who have been giving this matter most thorough study for the past eight years, show that sound yellow pine ties, thoroughly embedded in concrete, are almost indestructible.

Another and third objection made by the traction officials is that the car lines have to be diverted, either by means of laying a third and temporary track on the street to be improved, or if the street is so narrow as to prohibit this, there has to be an entire re-routing of the cars, causing by either method serious inconvenience to the public and disorganization of the car company's traffic schedule. This claim can also be overruled by a method which the speaker will outline to you later, as followed by the City of Baltimore.

The experience of all municipal engineers along this line has probably been the same.

Baltimore Work.—Owing to the flat refusal of the traction authorities to install permanent construction, many of us have had to resort to legislative bodies for relief. In the beginning of the year 1914 the situation in the City of Baltimore was thoroughly studied, both by the municipal engineers and the traction officials, with the result that the State Legislature of Maryland was appealed to by the muni-

* Chairman and Consulting Engineer, Paving Commission, Baltimore, before American Good Roads Congress, Pittsburgh.

cipality and a law was passed putting the character of foundation under the ties of the several street railway companies and steam railroads under the jurisdiction of the Paving Commission, with power to decide whether such foundation should be of plain ballast or concrete. The commission decided that in heavy traffic downtown streets concrete construction, 6 ins. thick, under and around the ties, was necessary, but that in the outlying suburban section where the traffic was light and street development more or less of an uncertainty, awaiting property development, rock ballast could be used.

The traction officials were informed that they could install the ties immediately on top of the concrete or install a cushion between the top of the concrete and the bottom of the ties. They chose the former.

It may be interesting to note here that in the downtown business section of Baltimore the streets are exceedingly narrow, not over 40 ft. in width between curbs, and there is no room for a temporary third track. Furthermore, the gauge is of odd dimension, namely 5 ft. 4½ ins., so that the track area takes up more space than in most cities. It was also impossible, owing to congestion, to divert the cars to other streets. In order, therefore, to meet this, the third objection of the traction officials, it became necessary to install the concrete without interruption to car traffic. It was at first thought that this could be done by blocking up the tracks an inch or so above the exact grade, installing the concrete, allowing it to set and lowering the tracks to the proper and exact grade. The conclusion was reached, however, that this would not only be very expensive, but hardly feasible, so that it was then determined to pursue the penetration method. This was done by bringing the tracks to the exact grade and ballasting with crushed stone from 1½ to 2½ ins. in size, free of dust and small particles, and tamping the same thoroughly as in ballasting ordinary track, care being taken to thoroughly tamp the ballast and make the same carry the strain of passing cars, then applying a thin cement grout.

In improving streets containing railway tracks the forces of the railway company and that of the paving contractor have to work in conjunction. The railway area is first graded out to the subgrade of the paving by the paving contractor. The railway company then takes charge and grades out to a point 6 ins. below the bottom of the ties. New rails and ties are then installed where necessary, together with any new special work. The ballast, of the size and depth previously noted, is then placed and thoroughly tamped under the ties and up to a point 2 ins. above the bottom of the ties, the rails brought to the proper grade and line, and when the entire construction is "tight" the penetration begins.

Grouting Mixture

The grouting mixture is composed of 1 part cement to 2 parts sand, and is about the consistency of thin cream. The operation is readily done without interruption to car traffic by the use of a small continuous mixer (known as the Coltrin mixer) placed just outside of and parallel with the railway tracks, with a flexible chute, in two sections, to convey the grout from the mixer to the ballast. Starting on the down-grade end and working up-grade, the thin grout is penetrated into the stone ballast, which, as previously noted, has already been securely tamped and made to carry the strain of the passing cars. As already noted, the chute is flexible and in two sections. When a car comes along the first section is thrown out of service and the second section is lowered to the ballast at about the ends of the ties and the mixer kept in service. After the car passes the first section is thrown back in service.

It is true that during this operation some movement occasionally occurs in the tracks, but there is a city inspector on the work at all times who hunts for and locates loose ties and they are immediately tamped up with green concrete.

The natural supposition is that sufficient movement of the ties and track would occur to injure the concrete while setting, but this is not true if the work is carefully handled and executed. On one street in Baltimore this work was successfully handled with five different lines of cars passing up and down the street with but 20 seconds headway at times during the day, while on another piece of work it was successfully installed with eleven different lines of cars passing over the special work with less than 20 seconds headway at short intervals during the day. The resultant mixture is about 1 of cement, 2 of sand and 5½ of stone, with the concrete very dense, as the ballast has been thoroughly tamped and voids reduced to a minimum.

This ends the work of the railway company, as after this section of concrete is installed, the paving contractor again takes charge, installing the concrete base for the pavement immediately on top of the railway base, and then the paving.

Bond Between Slab and Base

As a rule, there is no bond between the paving slab installed by the railway company and the paving base installed by the paving contractor, because generally the former is several blocks ahead of the latter, and in the meantime the concrete slab has set. This therefore overrules the second claim of the traction officials, and the penetration method pursued meets the third claim.

One of the principal points gained by this form of construction is that it shows up very clearly every weak place during the progress of the work. All loose or poorly tamped ties are made apparent by the bubbling or oozing up of the grout as a car passes over. Failures in finished pavement are avoided by immediately tamping such ties, which in many cases would otherwise have been overlooked. It has been found by careful cuts made in the finished work that this grout when properly applied penetrates the ballast to the subgrade, forming excellent concrete, and insures solid track construction, free from vibration, upon which the life of any pavement in the railway area depends.

From records kept and compiled by the Paving Commission it has been found that the total extra cost of this construction over plain ballast, including labor and material, is about 52 cts. per lin. ft. of single track.

In the last two years about 10 miles (single track) of such construction has been installed in the City of Baltimore by this process, in the busiest streets of the city, and car traffic interfered with to such a limited extent that you hear no complaint whatever from the traveling public during the course of the work. Included in the 10 miles of single track will be found all classes of paving within the railway area—sheet asphalt, wood block, granite block, vitrified block and scoria block.

Type of Pavement.—It has been suggested that this subject could properly include a discussion as to the type of pavement between and adjacent to the rails which has been found most satisfactory. The most satisfactory type of pavement in the railway tracks on heavy traffic streets is granite block, with a cement filler. Excellent results have been obtained in Baltimore with the recut granite. The old blocks are from 8 to 14 ins. in length. The 8-in. blocks are re-headed, while the 14-in. ones are split, making altogether, blocks smaller and much more uniform in size than the standard new block. The result is a very uniform, even surface, an excellent pavement for track areas.

On streets which may be half business and half residential, or in the retail districts, vitrified blocks should be used.

All block pavements should be laid on a cement-sand cushion.

On strictly residential streets of very light traffic sheet asphalt has been used, but the speaker rather deplores the use of this material within the track areas.

The block pavements are usually laid between the extreme outer rails, including the dummy, with two rows of liners on the outside of each outer rail. Selected granite block, on a mortar bed, is most desirable as liners on heavy traffic streets. On streets of lighter traffic and residential streets, wood block, 4½ ins. deep, thoroughly embedded in the concrete and on a mortar bed, give most excellent results as liners and an excellent finish to the street, particularly where sheet asphalt is laid from the rails to the gutters.

In order to cheapen the cost of track paving our policy the latter part of last year was to install sheet asphalt in the dummy strip, where there is very little traffic, and which will give good results if the track work is stable. We will follow this policy almost exclusively this year, as a modification of our former standard, where asphalt is used between the rails and curb.

Track Details.—The rails are usually of the Trilby type, 105 lbs. to the yard, 7 ins. deep, with a slight bevel on the outer paving edge. With this rail, and the use of steel tie plates and screw spikes, tierods may be eliminated, and by the elimination of the rods better results from a paving point of view are obtained. Tierods are a nuisance in track paving, causing a great amount of cutting if a block pavement is used, and usually have to be placed below the center of the rail in case sheet asphalt is used in order to have them in the concrete instead of in the binder.

Comparison of Mixing and Penetration Methods.—Good construction could unquestionably be obtained by the rerouting of the cars, either by means of a third track and cross-overs or by diverting the cars to other streets, thereby allowing the concrete to be placed by the ordinary mixing method and at the same time allowing time for the concrete slab to set before car traffic is again restored. While this method is a safer way, it is much more expensive than the penetration method. Unquestionably excellent results have been obtained by the latter method such as has been described, its attractiveness being that it is cheaper as to first cost, owing, principally, to the economical manner in which the materials can be handled, and it overcomes the principal objection of traction officials, namely interruption to car traffic, which is of course a serious objection.

In order to obtain good results with the penetration method, every detail must be carefully looked after by the inspectors, such as the quality and size of the stone composing the ballast, the tamping, and the mixing and placing of the grout. Frequent test holes should be cut in order to see that thorough penetration is secured, and wherever possible the penetration should be started at the down-grade end of a block and proceeded with up-grade.

Conclusions.—Under the old system of earth foundation or ballast, failures and troubles were numerous. Under the new system of concrete under the ties, installed as has been described, the percentage of trouble is infinitesimal, the principal defects being at crossings and around special work. It proves conclusively that for strictly up-to-date permanent construction, both for the street railway system and the pavement, the ties should be laid on a concrete base, from 6 to 8 ins. in thickness, and completely enveloped in the same.

The Western Canada Marble and Tile Company, Limited, Winnipeg, Man., have been incorporated.

Trade Inquiries

Names and addresses of inquirers may be obtained on application from the Department of Trade and Commerce, Ottawa.

177. **Asbestos cement building sheets and roofing shingles.**—A Glasgow firm would like to have direct quotations from manufacturers.

178. **Trinidad asphalt felt roofings.**—A firm in Glasgow is open to receive direct quotations from Canadian firms.

191. **Steel products.**—A Glasgow firm wishes to receive quotations for mild steel billets, blooms, slabs and sheet bars, mild steel round bars, etc., Siemens-Martin wire rods, Siemens-Martin soft drawn wire, bolts and nuts, rails, nails and kindred products.

203. **Mild steel.**—A Glasgow firm wishes to receive quotations c. i. f. Glasgow on mild steel butt welded tubes 1¼-inch o/d by 10 W. G. thick in lengths 13 feet, 13 feet 6 inches, and 14 feet, cut to dead lengths; also mild steel sheets from 13 to 17 W.G. to length and width which will be given, and mild steel bars 1 inch by 3-16 inch; 1 inch by ¼ inch; 1½ inch by 5-16 inch; 1½ inch by ⅜ inch; and 2 inches by ⅜ inch, also 15/16 diameter.

204. **Mild steel sheet bars or billets.**—A Glasgow firm wishes to receive quotations c. i. f. for the above 8 inches, 10 inches and 12 inches wide by 11 pounds to 50 pounds per lineal foot from 15 to 16 feet long. Are open to negotiate business to the extent of 1,000 tons weekly.

206. **Galvanized iron.**—A Scotch firm asks to receive quotations from Canadian exporters.

207. **Steel wire**—A Renfrew firm desires to hear from Canadian exporters of steel wire.

209. **Agency for iron and steel.**—A Glasgow firm formerly representing German exporting houses, wishes the agency of a Canadian iron and steel manufacturer with a view to future business. Territory: Scotland and the North of England. Best references.

Pro Patria

Lt.-Col. Stewart, senior member Stewart & Witton, Architects, Hamilton.
Col. Stewart is O. C. 86th Machine Gun Battery.

Personal

Mr. W. H. Fairchild, of Brantford, Ont., has been appointed city engineer of Galt, Ont.

Mr. S. C. Oxton has been appointed deputy minister of public works for the province of British Columbia in succession to Mr. C. H. Dancer, who has retired.

Lieut. Col. Henry E. Lordly, engineer in charge of construction of the Lachine Canal, Montreal, has been appointed as O. C. to organize a battalion of pioneers. The headquarters are at the Engineers' Armory, Point St. Charles.

Mr. J. L. Busfield on March 9 gave an interesting address before the Montreal Branch of the Canadian Society of Civil Engineers on the importance of architecture and exterior design in railway stations. Mr. Busfield was formerly assistant engineer in charge of the department of design when the Canadian Northern were preparing plans for their new terminals.

Mainly Constructional

Omer Frechette, contractor, Montreal, Que., is dead.

The Stanley Steel Co., Ltd., Hamilton, Ont., have obtained a charter.

The Frost Steel & Wire Co., Ltd., Hamilton, Ont., have obtained a charter.

The London Gas Power Company, Limited, London, Ont., have been granted a charter.

The Modern Heating & Engineering Co., Ltd. Montreal, Que., have been incorporated.

The D. B. Fegles Engineering & Construction Company, Fort William, Ont., have commenced.

Mr. Ross Thompson, a prominent builder and contractor of Simcoe, Ont., died on March 10.

The Phoenix Iron Works, Limited, has been incorporated; head office Vancouver, B. C.; capital stock $10,000.

The Security Engineering and Contracting Company, Limited, is a newly-incorporated Montreal concern with a capital stock of $25,000.

Mr. Charles H. Conery, of Guelph, Ont., who was well known all over Ontario and the West as a successful paving contractor, died on March 10th.

The Montgomery Faultless Hose Reel Company, 47 Gore Vale Avenue, Toronto, have been awarded the contract for 18 hose reels for the Royal Victoria Hospital, Montreal, Que.

A fire of unknown origin destroyed the old pier No. 2 at Halifax, N. S., on March 14, and the shipping facilities of the port will be somewhat hampered for a short time. The loss is estimated at $50,000.

The Compagnie Saint-Louis, Limitee, has been incorporated with a capital stock of $20,000 and head office in Montreal, and will carry on business as general contractors and builders. The company will also deal in engineers', builders', and contractors' supplies.

Edward Pelletier & Son, Quebec, have secured the contract for the construction of a chimney in segment blocks on Monnoyer's system, for the Monastry of the Franciscan Fathers, Quebec. The height of the chimney will be 70 feet, with a diameter of 30 inches at the top.

Plans to make Niagara Falls a city that will be in keeping with the world-famous scenic wonder already provided by nature were discussed at a recent meeting of the council of the Niagara Falls Board of Trade. Mr. Thomas Adams, the town planning expert of Ottawa, is to be consulted.

According to Richardson Builders, the contractors, the new University residence at Saskatoon, Sask., is to be completed in time for the fall term. Plasterers have been doing portions of the work for some time, but a larger force is now to be engaged so that the work may be pushed ahead.

La Compagnie Castonguay, Limitee, is the name of a newly-incorporated firm of general contractors with head office at Pointe-aux-Trembles and a capital stock of $10,000.

Satisfactory progress is being made on the new bridge spanning the Trent River at Trenton, Ont. The steel frame work is about completed and in position. It is confidently expected that the bridge will be in shape for travel when the river breaks up. It will be an up-to-date structure in every respect.

R. H. Fair, road superintendent, Frontenac County, reports an expenditure of $21,416 during 1915 on the Good Roads system. Major J. M. Sheppard, of Welland, states that that county expended last year $231,367, of which the Government grant amounted to $77,222; about 83 miles have been completed out of a total of 133, at an average cost of $5,000 a mile.

The sum of $240,000 has been voted by the Quebec Legislature for iron bridges. It was stated by the Hon. L. A. Taschereau that since the Government commenced its policy of helping municipalities, 356 bridges had been constructed at a cost of $2,200,000; 37 are in course of construction, at a cost of $500,000; and grants have been made for another 27. While the contracts are let by the municipalities, the Government usually make grants of half the cost, and in some instances these are on a higher scale.

A new bridge over the Niagara River is projected in the bill incorporating the Ontario-Niagara Connecting Bridge Company. Mr. E. R. Wood of Toronto heads the list of incorporators, which includes Robert P. Slater, merchant, of Welland; W. E. D. Mackenzie, merchant, of Chippewa; Alexander Fraser, barrister, of Niagara Falls; Edward G. Counette, president of the International Railway Company, Buffalo; F. O. Dudley, attorney, Niagara Falls, N.Y.; and A. J. Porter, president of the Shredded Wheat Company, Niagara Falls, N. Y. The bridge is not to be constructed until approved by the Canadian Government and the U. S. Congress, but the company may in the meantime acquire the lands and submit their plans to the Government.

At the 13th Annual Convention of the American Road Builders' Association held in Pittsburg recently the following resolutions were passed: That this association invites the attention of State, county and municipal authorities to the value of traffic censuses as a means of determining the relative values of various forms of pavement and road construction and would strongly recommend that systematic traffic censuses be taken from time to time on all classes of roads and pavements in order that more definite knowledge of the economic value of the different types of construction may be obtained. That this association urges that laws be passed and enforced in each state establishing reasonable limits for the weight, dimensions and speed of heavy motor vehicles.

Mr. George Bury, vice-president of the C. P. R., in the course of a short visit to Toronto recently, looked over the progress of work on the new Union Station site and the new station of the C. P. R. at North Toronto. Mr. Bury expressed himself as well satisfied with the work at both stations. He said that the contractors are expecting to commence installing the steel work about April 10, after which the remainder of the work will be rushed ahead. The station, said Mr. Bury, will be one of the finest on the North American continent.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Bromptonville, Que.
The Municipal Council intend to spend $3,000 on gravel roads this season. Secretary J. A. Ouellette.

Contrecoeur, Que.
The Village Council propose to spend $8,000 on macadam roads this season and the Parish Council $6,000. Secretary, J. B. Dupuy.

Donnacona, Qu.e
The Municipal Council have had plans prepared for a drainage system, estimated to cost $14,600. Engineers, Hamel & Tessier, 51 St. Pierre Street, Quebec.

Humberstone Township, Ont.
The Township Council have had plans prepared for drainage work, estimated to cost $4,000. Engineer, George Ross, McCaw Block, Welland.

Ottawa West, Ont.
C. H. Phinney, C.E., 110 Wellington Street, is preparing plans for a road, estimated to cost $3,000.

Sarnia, Ont.
The City Council are considering the remodelling of the waterworks system and have appointed as Consulting Engineers R. S. and W. S. Lea, 10 Cathcart Street, Montreal, and F. W. Thorold, 2 Toronto Street, Toronto.

St. George, Que.
The Municipal Council propose to spend $4,000 on roadwork this season. Secretary, George Picher.

St. Jacques Le Mineur, Que.
The Municipal Council are considering the construction of cement sidewalks. Secretary, J. A. Tetrault.

Welland, Ont.
George Ross, McCaw Block, has plans in course of preparation for the following works:—drainage, $5,000; sidewalks, $1,500, pavements, $10,000, sewers $1,000.

Wickham West, Que.
The sum of $8,000 will be expended on macadam roads this season. Secretary to the Municipal Council, L. de G. Dagnault, St. Nazaire d'Acton.

Willowdale, Ont.
Wrights Ltd., 22 College Street, Toronto, propose to lay a large quantity of macadam roadway in Kingsdale Subdivision this summer.

CONTRACTS AWARDED

Elma ownship, Ont.
The contract for the construction of the Peet drain has been let by the Township Council to Joseph McDonnell, Rostock.

Willowdale, Ont.
The following contracts have been let bp Wrights Ltd., 22 College Street, Toronto:—14,000 feet of cement sidewalk in North Kingsdale Subdivision, Else & Tiplady, 209 Weston Road; 7,000 feet of cement sidewalk in Duchess Sub-division, South Kingsdale, A. Simone, 414 Balliol Street, Toronto; 20,000 feet of sewer in Duchess Sub-division, A. Simone.

Railroads, Bridges and Wharves

Alberta Province.
The Provincial Department of Public Works have included in their estimates the sum of $215,000 for bridges. Minister, J. R. Stocks, Edmonton.

Arthur, Ont.
Tenders on the erection of a concrete bridge for the Township Council will be received until March 27th. Engineers, Bowman & Connor, 31 Queen Street W., Toronto.

Culross Township, Ont.
The Township Council propose to build a bridge over the Teeswater River on Concession 6. Clerk, C. Button, Teeswater.

Peterborough, Ont.
The City Council are having plans prepared for a bridge over the Otonabee River, estimated to cost $3,117. Engineer, R. H. Parsons.

Port Hope, Ont.
Tenders on the construction of a concrete bridge for the Town Council will be received until March 25th. Engineers, Bowman & Connor, 31 Queen Street W., Toronto.

Simcoe County, Ont.
Tenders will be received until March 27th for the construction of concrete abutments for a steel bridge to be erected over the Nottawasaga River for the County Council. Consulting Engineer, F. Barber, 57 Adelaide Street E., Toronto.

Public Buildings, Churches and Schools

Acton Vale, Que.
The School Board propose to build a convent. Secretary, J. C. St. Pierre.

Avon, Ont.
The School Trustees are considering the erection of a school to replace that recently destroyed by fire. Estimated cost, $6,000. Secretary, Gilbert Windsor, Avon School, Putnam.

Bathurst, N. B.
The Eudist Fathers, West Bathurst, contemplate the erection of a college, estimated to cost $200,000. Particulars from Rev. Father La Bastard, Bathurst.

Creston, B. C.
The erection of a High School has been recommended by Inspector Dove, Nelson.

Fairbank, Ont.
The Congregation of Oakwood Methodist Church propose to erect a new building. Pastor, Rev. H. Pawson, 1 John Stearne Street.

Fitzroy Township, Ont.
The Township Council propose to submit a by-law to authorize the raising of $10,000 for the erection of a school at Kinburn. Clerk, William Boyle, Kinburn.

Fort William, Ont.
The Board of Education have had sketch plans prepared for an addition to the Collegiate Institute. Architect, R. E. Mason, Room 13, Victoria Block. Approximate cost, $75,000.

Hamilton, Ont.
The Hamilton Public Library Board propose to build a number of branch libraries and to issue $50,000 debentures for this purpose. Secretary Adam Hunter, 126 Duke Street.

Kinburn, Ont.
J. P. MacLaren, 104 Sparks Street, Ottawa, is preparing plans of a school for the Public School Board. Estimated cost, $10,000. Brick construction.

Leclercville, Que.
The School Board propose to build a school at an approximate cost of $8,000. Particulars from M. D. L. Filteau, Leclercville.

Ponoka, Alta.
The Provincial Department of Public Works have made provision in their estimates for alterations to the Asylum, estimated to cost $30,000. Architect, R. Blakey, Parliament Buildings, Edmonton.

Red Deer, Alta.
Provision has been made in the current estimates of the Provincial Department of Public Works for alterations to the Court House, estimated to cost $3,000.

St. Agathe, Que.
The Roman Catholic Congregation propose to build a presbytery, estimated to cost $12,000. Curate, Rev. A. Turcott.

St. Evariste De Forsyth, Que.
The School Board contemplate the erection of a school, at an approximate cost of $10,500. Secretary, J. Boutin.

St. Madeleine, Que.
The School Commission may erect two schools this season. Estimated cost, $5,000. Secretary, T. D. Rainville.

St. Rose Du Degele, Que.
Plans have been prepared for interior alterations to the Roman Catholic Church. Architect, J. P. Ouellet, 28 St. Famille Street, Quebec. Estimated cost, $20,000.

CONTRACTS AWARDED

Bishop's Crossing, Que.
The School Board have let the general

contract for the erection of a school to C. H. Parker, Lennoxville Street, Sherbrooke. Work will start early in the spring. Estimated cost, $7,000.

Cartierville, Que.
In connection with the church basement which is now being constructed for the Roman Catholic Congregation, the contract for temporary heating, plumbing and roofing has been let to Camille Legault, Cartierville.

Moncton, N. B.
The contract for the supply and installation of seating and desks at the Aberdeen School has been awarded to B. E. Smith, 814 Main Street, at $3,178.

Montreal, Que.
The Roman Catholic School Commissioners have let the general, heating, plumbing and ventilating contracts for the erection of a school on Papineau Avenue to J. Laurier, 355 Providence Street. Approximate cost, $176,700.

Orford Township, Ont.
The general contract for the erection of a school for School Section No. 7 has been awarded to Horton Bros., St. Thomas, Ont. Approximate cost, $5,000.

Repentigny, Que.
The contract for the erection of a school for the Roman Catholic School Board has been let to Telesphore Rivet.

Stanstead, Que.
The contract for electrical work at the new Registry Office has been awarded to the Electrical Repair & Supply Company, 71 Wellington Street, Sherbrooke.

Toronto, Ont.
The Military Hospital Commission have let the general contract for alterations to the old Knox College to W. B. Charlton, 412 Indian Road. Building is to be converted into a Hospital and Home.

Business Buildings and Industrial Plants

Alberta Province.
The Alberta Farmers Co-Operative Elevator Company, Ltd., Lougheed Building, Calgary, propose to build about thirty elevators in various parts of the Province.

Anderdon Township, Ont.
John Beaudoin proposes to erect fireproof farm buildings in the spring, to replace those recently destroyed by fire. Approximate cost, $3,500.

Banner, Ont.
H. Thornton will erect a cement silo in the spring.

Brantford, Ont.
Plans are being prepared for a garage to be built for C. J. Mitchell, 55 Darling Street. Architect, L. H. Taylor, 13 St. George Street. Brick and mill construction. Estimated cost, $20,000.

Brockville, Ont.
R. Johnston is building an addition to the Revere Hotel. Stone and brick construction. Work by day labor.

Chatham, Ont. 6
Plans are being prepared by Adams & Adams, Market Chambers, for a warehouse estimated to cost $12,000 and two residences.

Freeborn, Ont.
J. J. Carson, Freeborn, Millbank, is considering the erection of a large cement silo.

Gesto, Ont.
The following parties propose to build new barns in the spring: Mark Heaton, Clarence Batten, J. Calhoun, Fred Howson.

Grey Township, Ont.
The erection of a drive shed is being considered by D. Machan, Grey Township, Brussels. Cement construction.

Hamilton, Ont.
McPhie, Kelly & Darling, Bank of Hamilton Building, are preparing plans for a number of factory extensions. Estimated total cost, $43,000.

The Stanley Steel Company, recently incorporated with a capital of $2,500,000, will have plans prepared at once for a steel plant. Vice-President, A. F. Hatch, 73 Sherman Avenue.

Plans are being prepared for alterations to an elevator at King and Hughson Streets for Thomas C. Watkins, 550 Jarvis Street, Toronto. Architect, A. W. Peene, Clyde Building. Estimated cost, $3,000.

Plans and specifications are being prepared for the erection of a knitting factory for the Mercury Mills, Ltd., 80 Park Street N., and tenders will be called shortly. Architect, C. T. Main, 201 Devonshire Street, Boston, Mass. Approximate cost, $250,000.

Kirkdale, Que.
A. B. Gow proposes to edect a steel barn this season, at an approximate cost of $6,000.

Manseau, Que.
Savoie & Cie., Manseau, P. O., intend to build a sawmill this season. Estimated cost, $4,000.

Markham, Ont.
The Markham Agricultural Society will call for tenders for the erection of an Agricultural Building at the Fair Grounds. Estimated cost, $6,000. Secretary, A. W. Milne.

Montreal, Que.
The Metropalitan Columbus Association 255 Mountain Street, contemplate the erection of a Club House, at an approximate cost of $190,000. Architect not yet appointed.

Ottawa, Ont.
John Soublien, 207 Booth Street, is about to commence the erection of a bakery. Brick construction.

The Knights of Columbus propose to erect a Club building in the West End. Secretary, Francis E. Higgerty, 54 Somerset Street.

Blackburn Bros., Union Bank Building, have applied to the Board of Control for permission to build an additional two storeys to an office building at Sussex and Rideau Streets. Estimated cost, $18,000.

Russeldale, Ont.
Alexander Park, proposes to build a large cement silo in the spring.

Sebringville, Ont.
Aaron Werner proposes to build a store in the spring, at an approximate cost of $3,000.

Spirit River, Alta.
Owens & Johnson have let the general contract for the erection of a store, but will supervise construction themselves.

St. George, Que.
J. Gagnon proposes to build a store, at an approximate cost of $10,000.

G. P. Gonthier will build a foundry, at an approximate cost of $4,000.

A store will be built by Gedeon Gagne, at an approximate cost of $6,000.

The erection of a store is being considered by Octave Papillon. Estimated cost, $4,000.

Mathias Fournier proposes to rebuild his hotel, at an approximate cost of $3,600.

Staffordville, Ont.
The erection of farm buildings is being considered by Vern Gunstone. Timber and cement construction.

Tillsonburg, Ont.
The Tillson Company, Broadway Street, will shortly make repairs to their premises.

Toronto, Ont.
W. H. Gibbs, Brock Avenue, is receiving tenders on alterations to stores at 325 Symington Street.

Harry Webb Company, Ltd., 23 Buchanan Street, contemplate the erection of a warehouse and bakery.

J. F. Hartz Company, Ltd., 24 Hayter Street, propose to build a warehouse shortly.

Plans are being prepared by the Toronto Hydro Electric System, 226 Yonge Street, for additions to their sub-stations on Junction and Duncan Streets, and tenders will be called shortly. Steel and brick construction. Estimated cost, $35,000 and $75,000.

Walkerton, Ont.
John Ward, Walker House, is considering the remodelling of his premises, at an estimated cost of $5,000.

Welland, Ont.
T. L. Nichols, 18 Main Street S., is preparing plans of a business building to be erected for Elio Sogovac. Estimated cost, $7,000.

Westboro, Ont.
J. A. Clark, Richmond Road, has commenced the erection of a store. Brick veneer construction. Estimated cost, $4,000.

Winnipeg, Man.
The erection of a large mail order warehouse is being considered by the Galloway Mail Order Company, c/o Stewart & Walker, Ltd., 202 Sterling Bank Building.

Wyoming, Ont.
William Travis is considering the construction of a planing mill, at an estimated cost of $4,000.

CONTRACTS AWARDED

Colquitz, B. C.
The general contract for the erection of a building for the British Columbia Telephone Company, Vancouver, has been let to James Smethurst, 1110 Princess Avenue, Victoria.

Guelph, Ont.
The general contract for the erection of a stove factory has been let to J. W.

Oakes, Kathleen Street. Approximate cost, $7,000. Architect, W. A. Mahoney, Telephone Building.

Lake Louise, Alta.
The general contract for the erection of a kitchen and stores building at the hotel owned by the Canadian Pacific Railway has been awarded to Carter-Halls-Aldinger, 1010 Union Bank Building, Winnipeg.

London, Ont.
The contract for installation of a refrigerator plant at the premises of Smallman & Ingram, Dundas Street, has been let to the Canadian Ice Company, Chestnut Street, Toronto.

Merriton, Ont.
The general contract for the erection of an addition to the mills of the Interlake Tissue Mills, Ltd., has been awarded to W. J. Trimble, 76 Adelaide Street W., Toronto. Steel, concrete and brick construction. Approximate cost, $40,000.

Montreal, Que.
The following contracts have been let in connection with the factory now being built for Darling Bros., 120 Prince Street:—cut stone, J. Quinlan & Company, 4414 St. Catherine Street; reinforcing steel, Trussed Concrete Steel Company, 59 Beaver Hall Hill; roofing, Hickey & Aubut, 90 Dominion Street; metal sash, David McGill, 320 Lagauchetiere Street; plumbing, Thomas O'Connell, 183 Ottawa Street.

The contract for the erection of a factory for Darling Bros., 120 Prince Street, has been awarded to A. F. Byers & Company, 340 University Avenue, and work has been started. Estimated cost,-$19,000. Brick construction.

Ottawa, Ont.
The contract for marble work in connection with interior alterations to the premises of the Merchants Bank of Canada has been let to Smith Marble & Construction Company, Ltd., Van Horne Avenue, Montreal.

Port Aux Trembles, Que.
The general contract for the erection of an office building for the Imperial Oil Company has been let to James Shearer Company, Ltd., 225 St. Patrick Street, Montreal, the contract for reinforcing steel to W. H. Wardell, New Birks Building, Montreal, painting to Nash & White, Ltd., 397 Victoria Avenue, Westmount, heating and plumbing to M. J. Quigley, 4228 St. Catherine Street, Westmount, and roofing to Sibley & Huot, 34 St. Martin Street, Montreal.

Prescott, Ont.
The contract for the installation of a heating plant at the premises of the Newell Manufacturing Company has been let to George Appleton, Prescott.

Quebec, Que.
The general contract for the erection of a store for J. N. Rondeau, 6 Lachevrotiere Street, has been awarded to J. Breton, 175 St. Olivier Street. Frame and brick construction. Approximate

St. Hubert, Que.
The following contracts have been let for the construction of an auto race track for the Canadian Speedway Company, Ltd., 67 Dandurand Building, Montreal:—erection of garage and machine shops, A. F. Byers & Company, Ltd., 340 University Street, Montreal; fireproof partitions, floors, etc., Douglas Milligan Company, 609 New Birks Building, Montreal; steel work, Phoenix Bridge & Iron Works, Ltd., 83 Colborne Street, Montreal; construction of speedway, Raymond Construction Company, Ltd., 145 St. James Street, Montreal; plumbing and drainage, R. G. Williams & Company, St. Lambert, Que.; construction of club house, Deacon Construction Company, Ltd., 37 Mayor Street, Montreal.

St. Rose, Que.
The following contracts have been let in connection with the premises now in course of erection for the Provincial Bank, Montreal:—electrical work, J. A. St. Amour, 2173 St. Denis Street, Montreal; painting, B. Navert, 1228 St. Denis Street, Montreal; wood and tile work, Lacroix & Vezeau, 291 De Montigny Street, Montreal.

Toronto, Ont.
In connection with the factory which has been built at 725 King Street W. for R. G. Long & Company, 439 Wellington Street W., the contract for electric wiring has been let to Rogers Electric Company, 145 Queen Street W.

Work has been started on the erection of a mill for the York Knitting Mills, Ltd., 993 Queen Street W. The contract for excavation has been let to E. Corner, 698 Manning Avenue, and the masonry to Brown & Love, 46 Price Street.

Vancouver, B. C.
The general contract for repairs to the store and apartments at 872 Granville Street for Evans, Coleman & Evans has been let to Baynes & Horie, 836 Howe Street. Approximate cost, $10,000.

In connection with the theatre which is being built at Broadway and Main Streets for C. M. Bowman, Southampton, Ont., the following contracts have been let:—sheet metal work, New Idea Sheet Metal Works; electrical work, Jarvis Electric Company, Ltd., 570 Richards Street; heating, Moscrop Bros., 861 Seymour Street; plumbing, Barr & Anderson, 1060 Homer Street.

Windsor, Ont.
Work is about to start on repairs to a dairy lunch on Sandwich Street W. for Ernest White. The contract will be let to R. Wescott, 55 Oak Avenue. Approximate cost, $3,000.

Winnipeg, Man.
The contracts for masonry, carpentry, steel work, roofing and fireproofing required in the erection of the Eaton warehouse have been awarded to the general contractors.

Residences

Acton Vale, Que.
N. Gagnier contemplates the erection of a residence.

Brantford, Ont.
Tenders on the erection of a residence for E. L. Gould, 103 Darling Street, will be called about the end of the month by the Architects, Barber & Tilley, Temple Building. Estimated cost, $8,000.

Britannia Bay, Ont.
H Shipman, Hope Building, Ottawa, is building a residence, estimated to cost $3,000. Frame construction.

Elora, Ont.
Fred Daub, c|o Elora Furniture Company, proposes to build a residence in the spring. Approximate cost, $3,500.

Fonthill, Ont.
A. E. Nicholson, Queen Street, St. Catharines, has prepared plans of a residence to be built for F. Wellington, c|o Stone & Wellington. Tenders will be called shortly.

Hamilton, Ont.
R. S. Mason, 43 Kensington Avenue, is about to start work on the erection of three residences, estimated to cost $2,500 each. Brick construction.

La Tuque, Que.
G. Harvey proposes to rebuild his residence, at an approximate cost of $4,000. Frame and brick construction.

London, Ont.
George Churchill, Barrington Street, West London, is preparing plans for two residences, estimated to cost $3,600. Frame construction.

D. J. Ferguson, 503 Quebec Street, is preparing plans for a residence to be erected on Dufferin Avenue, at an approximate cost of $4,000. Red pressed brick construction.

Plans of a residence to be built on Colborne Street are being prepared by James R. Haslet, 521 Richmond Street. Red pressed brick construction. Approximate cost, $3,500.

C. J. Pink, 451 Hamilton Road, is considering the erection of a residence, at an estimated cost of $3,500.

The erection of a residence is being considered by T. Dixon, c|o London Post Office. Estimated cost, $3,000.

Marieville, Que.
Agenor Fontaine proposes to erect a concrete residence. Estimated cost, $3,000.

Montreal, Que.
J. Bisschop, 201a Wilfe Street, is about to start work on the erection of two residences, estimated to cost $3,500. Brick construction.

Ottawa, Ont.
J. P. Rady, 482 Lisgar Street, is considering the erection of a number of residences in Ottawa South at an epproximate cost of $3,800 each. Brick veneer construction.

J. B. Younghusband, 6 Spruce Street, is about to erect apartments on Nelson Street. Estimated cost, $10,000. Smaller trades will be let. Brick veneer construction.

Raleigh Township, Ont.
Adams & Adams, Market Chambers Chatham, are preparing plans of a residence for George Davidson, R. R. No. 6, Chatham. Estimated cost, $3,000.

Russeldale, Ont.
Plans of a residence are being prepared by John Sawyer. Pressed brick construction. Estimated cost, $3,500.

St. George, Que.
George Picher intends to erect a residence this season, at an approximate cost of $3,000.

Theodule Drouin contemplates the erection of a residence, estimated to cost $3,000.

Charles Grandin contemplates building a residence, at an approximate cost of $4,000.

St. Joseph, Que.
The erection of a residence is being considered by Valere Gilbert.

Odilon Cliche contemplates the erection of a residence. Estimated cost, $4,000.

Toronto, Ont.
T. Robertson, 89 Elm Avenue, has had plans drawn for an addition to his residence, and will start work shortly. Estimated cost, $3,000. Brick construction.

The erection of a residence on Warren Road is contemplated by H. E. O'Neil, 211 Howard Park Avenue.

Hayward & Whitehorn, 6 Hallam Street, are receiving tenders on heating, plumbing and electric wiring required at the residence at 19 Lauder Avenue. Particulars on job.

The erection of a residence is being considered by P. L. Spiers, 95 Gladstone Avenue. Approximate cost, $4,500. Brick construction.

Welland, Ont.
S. L. Lambert, 172 Main Street W., proposes to erect an apartment house on North Main Street, and is having plans prepared by T. L. Nichols, 18 Main Street S. Approximate cost, $10,000. Cement and brick construction.

Willowdale, Ont.
J. B. McKenzie proposes to erect a residence this spring in the Kingsdale Sub-division.

Wolseley, Ont.
A. Abell proposes to build a residence in the spring.

Plans of a residence will be prepared by W. Ward. Estimated cost, $3,000. Work will start in the spring.

Woodstock, Ont.
B. McNichol, Architect, Mary Street, has prepared plans for three residences, estimated to cost $5,200, $4,600 and $2,900 respectively.

Yamaska County, Que.
The erection of a residence is being considered by Antonio Lemire, St. Antoine de la Bie du Febvre.

CONTRACTS AWARDED

Hamilton, Ont.
Plans have been drawn for two residences to be built on Garfield Avenue for Thomson & Thomson, Federal Life Building. The masonry contract has been awarded to D. Jones, 220 Maple Avenue, the carpentry and roofing to J. A. Jones, Station No. 6, Hamilton Beach, and the plastering to J. L. Wallace, Stoney Creek. Approximate cost, $4,600.

Montreal, Que.
The general contract for alterations to a residence on Pearl Street for A. P. Stuart, 27 Summerhill Avenue, has been awarded to D. F. Des Lauriers, 343 Richelieu Street, Montreal West. Sub-contracts will be let.

Ottawa, Ont.
The general contract for alterations to the residence of W. M. Southam, Rockliffe Park, has been awarded to A. Christie & Son, 253 Frank Street.

Quebec, Que.
The general contract for the erection of a residence for C. R. Falardeau, 225 Ste. Helene Street, has been let to T. Mathieu, 109 Third Street, Limoilou, Frame and brick construction. Approximate cost, $3,000.

Thorold, Ont.
The contract for rebuilding the residence of Mrs. T. Baxter has been let to H. W. Stickle, Thorold. Estimated cost, $5,000.

Toronto, Ont.
J. Durham has let the general contract for the erection of three residences to George Bailey, 79 McKay Avenue. Approximate cost, $15,000. Brick construction.

Woodrooffe, Ont.
In connection with the residence which is being built by F. Harry, the contract for electrical work has been let to P. Ackroyd, 416 Bank Street, Ottawa.

Power Plants, Electricity and Telephones

Alberta Province.
The Department of Public Works, Edmonton, have made provision in their estimates for telephone construction, estimated to cost $250,000.

Kintore, Ont.
The Village Council propose to construct a transmission line from Thamesford to Kintore. Clerk, William Crellin.

Lyndhurst, Ont.
G. E. Roddick intends to construct a transmission line from Lyndhurst to Delta, a distance of five miles, and will require transformers and No. 6 copper wire.

Mt., Forest Ont.
The Mt. Forest, Wellington and Grey Telephone Company propose to build a number of extensions to their system. Manager, J. B. Moon, Mt. Forest.

Port Dover, Ont.
The Town Council will ask the Hydro Commission for estimates on the installation of a light and power system. Clerk, James Sloan.

Toronto, Ont.
The Toronto Hydro Electric Commissioners 226 Yonge Street, will receive tenders until March 28th for the supply of Watt Hour Meters. Specifications at office of the Purchasing Agent, 15 Wilton Avenue.

The Toronto Hydro Electric System, 226 Yonge Street, propose to do a considerable amount of underground conduit work this summer. Estimated cost, $85,000.

CONTRACTS AWARDED

St. Albans, Que.
The Portneuf Hydro Electric Company have let the contract for hydro equipment for their new plant to William Hamilton, 179 Reid Street, Peterborough, Que.

Fires

Birchcliffe, Ont.
Residences of A. Partridge and Thomas Holm. Loss, $1,500 and $1,200.

Calgary, Alta.
Incinerator owned by the City. Loss, between $10,000 and $15,000.

Campbellton, N. B.
Hotel Waverley, Water Street, owned by A. J. Gorman. Totally destroyed.

College Bridge, N. B.
Residence of P. D. Vinneau, totally destroyed. Loss, $2,500. Will rebuild at once.

Cyrville, Ont.
Convent of the Sisters of Wisdom, totally destroyed. Loss, $8,000.

Forest, Ont.
Marble works owned by J. Rupp.

Fruitvale, B. C.
Hotel owned by W. R. Mellard, completely destroyed. Loss, $8,000.

Gleichen, Alta.
Business block, tenanted by Beach Saddlery, Bray's Hardware Store, Cosgrove Hardware Store, Farmers Supply Company, Masonic Rooms, Corey Law Office, Central Telephone Office. Loss, about $100,000.

Grafton, Ont.
Residence owned by the Misses Cameron totally destroyed.

Halifax, N. S.
Pier No. 2, owned by the Department of Public Works, Ottawa. Loss, about $50,000.

Hamilton, Ont.
Factory of the Diamond Glass Company. Loss, about $4,000.

Montreal, Que.
Sawmill owned by Pauze & Gohier, 1822 Cote des Nieges Road. Loss, $7,000.

Neepawa, Man.
Store owned by John Brown & Sons. Loss, about $14,000.

New Liskeard, Ont.
Hall owned by J. Grills and used as a Salvation Army Barracks, totally destroyed.

Renfrew, Ont.
Factory of the Renfrew Machinery Company totally destroyed with contents. Loss estimated at $100,000. Will rebuild immediately.

St. Andrews, Ont.
Cheese factory owned by S. G. Lawson. Loss, $5,000.

St. Catharines, Ont.
Cuthbert Pattern Works, Brewery Street. Loss, $3,000.

St. George, Ont.
Storage building owned by R. Bell & Son Company, Ltd. Loss, $10,000.

St. Remi De Tingwick, Que.
Parish church entirely destroyed. Loss, $22,000. Will rebuild at once. Curate, Rev. J. O. Melancon.

Stoney Point, Ont.
Residence of Peter Mailloux.

Stettler, Alta.
Barracks of the Royal Northwest Mounted Police entirely destroyed. Owned by the Department of Public Works, Ottawa.

Stratford, Ont.
Office, furnace room and store room at the factory of the Macdonald Thresher Company. Loss, about $5,000.

Tillsonburg, Ont.
Shoe store of H. Swartz, Weeke's barber shop and Gerow's restaurant

Miscellaneous

Elmira, Ont.
Otto Rudisluela is receiving prices on a hand-power freight elevator. Capacity, 4,000 pounds.

Galt, Ont.
The Town Council are considering the purchase of a motor fire engine. Clerk, Joseph McCartney.

London, Ont.
Fire Chief John Aiken has been authorized to purchase 1,000 feet of rubber lined hose and a number of fire alarm boxes.

Montreal, Que.
Tenders on the supply of cement, sand, concrete, stone, gravel, rails and angle bars will be received until noon, March 24th, by the Secreary to the Harbor Commissioners, David Seath, Common Street. Engineer, R. W. Cowie.

CONTRACTS AWARDED

Hamilton, Ont.
The City Council have awarded the following contracts for supplies:—vitrified brick, Metropolitan Paving Brick Company, Campden, Ohio; cement, Alfred Rogers, 28 King Street W., Toronto; asphalt, Warner Quinlan Company, 79 Wall Street, New York; creosoted wood blocks, Creosoted Block Paving Company, C. P. R. Building, Toronto; sewer pipe Hamilton & Toronto Sewer Pipe Company, Ltd., Wentworth Street .. and Sackville Hill, 52 Elgin Street.

Kingston, Ont.
The following contracts for supplies have been awarded by the City Council:—cement and lumber, Frontenac Lumber & Coal Company, Ontario Street; hardware, W. A. Mitchell, Princess Street; rubble Stone, Rody & Monk, Patrick Street; sand, Kingston Sand and Gravel Company, Raglan Road; sewer pipe, Hamilton & Toronto Sewer Pipe Company, Hamilton; one concrete and asphalt mixer, F. D. Cummer & Son Company, Cleveland, Ohio, at $6,500.

Quebec, Que.
The contract for the construction of a monnoyer ferro-concrete chimney for the Franciscan Brothers, 180 Grand Allee, has been awarded to Edouard Pelletier & Fils, 111 Colomb Street.

Vancouver, B. C.
The City Council have let the following contracts for supplies:—cement, Balfour, Guthrie & Company, 739 Hastings Street W., Evans, Coleman & Evans, Ltd., 407 Granville Street, and Winch & Company, 739 Hastings Street W.; castings, Vancouver Engineering Works, 519 Sixth Street W.

Gasoline Locomotives Safe in Tunnel Work if Properly Run

Gasoline locomotives used in mine and tunnel work may develop a quantity of carbon monoxide as great as 5¾ per cent. of the piston displacement, which makes them dangerous to health if operated in headings where a good ventilating system is lacking. This occurs, according to O. P. Hood and R. H. Kudlitch, who have just completed a careful series of experiments announced in Bulletin 74 of the U. S. Bureau of Mines, only when the locomotive is running at full load on an excess of gasoline. The maximum efficiency for the weight of gasoline consumed, and also the least amount of carbon monoxide, was reached when the locomotives tested were running at 85 per cent. of capacity on a mixture just rich enough to avoid back-firing. Consequently it appears that if locomotives of excess capacity be operated so as to obtain the greatest fuel economy, there is no danger, in using them in tunnel headings, from the highly poisonous gas, carbon monoxide. The quantity of this gas given off under these conditions amounts to one-third of 1 per cent. of the piston displacement. To reach this condition for any given load and position of throttle the operator should close the needle valve until occasional backfiring occurs and then open it just enough to prevent further backfiring. If a first-class ventilating system exists there is little danger from carbon monoxide poisoning in any case, but the locomotives should be operated in the manner outlined because of other considerations. When running as described the cylinders stay cleaner. When the cylinders become coated with carbon it interferes with the cooling system, causes trouble with the spark plugs, and induces overheating. This in turn results in disagreeable "smoke" from burning lubricating oil. In addition to fuel economy the life of the locomotive is increased by careful operation.

According to these men, American gasoline locomotives are not entirely safe in headings where gas or dust is present in sufficient quantities to form an explosive mixture with the tunnel air. American manufacturers have not yet appreciated the demand for a locomotive that is entirely proof against the emission of flames from the muffler or carbureter, and against sparking outside the cylinders. Such locomotives, having closed ignition circuits and other devices, are in use in Europe, and are considered perfectly safe under any conditions in which men are able to work.

Gasoline for locomotive use should not be stored underground in pump chambers or other places where the ventilation is poor. These experiments show, however, that where there is a good current of air the gasoline, even if spilled in quantities, will not evaporate fast enough to produce an explosive mixture.

Improvised Blow Torch Heats Concrete Inside the Mixer

An improvised kerosene blow torch with its flame directed into the mixed barrel employed for heating the concrete aggregates on New York subway work during cold weather was described by Robert Ridgway, engineer of subway construction for the Public Service Commission, in a paper read before the twelfth annual convention at Chicago of the American Concrete Institute. The paper quoted a report by Andrew Veitch, assistant division engineer of the commission, on this device.

The U. S. Realty & Improvement Company and the Rapid Transit Subway Construction Company, contractors on Seventh Avenue for routes 4 and 38, sections 5 and 6, are using, as described in this report, an attachment placed on the mixer which forces a flame or hot blast directly into the mixer, thus raising the concrete to the desired temperature while it is being made. Almost any degree of heat may be obtained by leaving the materials in the mixer different lengths of time. If the heat tends to dry out the mix, sufficient water may be added to maintain the right consistency for use.

The apparatus itself consists of the ordinary kerosene blow torch inserted in a large pipe placed at the hopper through which the heat is forced and directed into the mixer. A 30 gallon kerosene tank is placed on top of the mixer, from which the oil feeds into the burner. Here it is vaporized and burns, the flame being forced into the mixer by a blast of compressed air. This air is supplied by a direct connection to the contractors' air lines feeding the rock drills. It is evident that in using this method the contractors are able to make a considerable labor saving in eliminating rehandling of the materials to heat them. Also it is possible to save much space formerly required on the street for this purpose, as with this arrangement materials can be mixed and placed as fast as they are delivered from the docks or store yards.

Concrete Pavement Struck Crosswise at Steel Expansion Joints

In building a concrete road at Tonowanda, N. Y., a novel method was used to bring the Baker steel expansion joints at the exact level of the surface of the concrete, or slightly below it. The men operating the strike board were instructed not to work closer to the joint than 2 feet, but to be sure to leave the concrete around the joint a little high. The clamps holding the several parts of the point together were left in place for more than half an hour. The finishers were then required to wade in the unsurfaced strip of concrete next the joint, and, by the use of 3 foot straightedge, cut the concrete down to the level of the finished pavement adjoining, using the top of the steel joint as a template to support one end of the straightedge. In this way no abrupt changes in level were possible at the joints, and the concrete was made to meet exactly the top of the steel.

Submit Report on Building District and Limits for New York

The commission on building districts and restrictions appointed by the Board of Estimate of New York City to consider and report on a districting plan for the purposes of regulating the height of buildings, the area of courts and yards, and the location of trades and industries has just issued a progress statement of its plans and filed detailed maps showing the suggested districts and proposed limitations. If the report of the commission is adopted by the Board of Estimate after public hearings, it will become law.

The commission desires thorough study of the proposed plans, and urges property owneds and civic organizations to inspect the proposed district maps with reference to their particular localities, so that mistakes can be avoided and the proposed maps perfected before submitting them to the Board of Estimate. Edward M. Barrett is chairman of the commission and Robert H. Whitten is secretary. George B. Ford is consultant to the commission, which has in its membership representatives of the real estate and civic interests of the city.

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Vol. 30 **March 29, 1916** **No. 13**

Principal Contents

Keep the Home Fires Burning

The all-important work of the British Empire to-day is a vigorous, systematic, well-organized prosecution of our war. This applies equally to Canada, as the most important colony of the Empire. Yet Lord Shaughnessy says he is not satisfied of the wisdom of raising a half-million men at the present time and by the present methods.

Now, people are apt to listen when Lord Shaughnessy talks. Some way or other we Canadians have got into the habit of believing in this big man who does things. So, when he makes a public statement (which isn't often) we have felt that it carries the weight of a tremendously wide and ripe experience backed by sound common sense. If there is any one outstanding figure in this Dominion to whom the word "can't" is a stranger, it is surely Lord Shaughnessy. He is Canada's big man—big through hard work, undoubted ability, unconquerable determination, unlimited confidence in Canada and in Canada's resources.

* * *

And now along comes Lord Shaughnessy's statement that he is not satisfied of the wisdom of raising half a million men in Canada for military service under the present system. The press is saying, and some of our politicians—mere opportunists by comparison—that Lord Shaughnessy is all wrong.

Are two soldiers poorly equipped and badly trained of more value on the fighting line than one properly equipped and sufficiently trained? If so, Lord Shaughnessy is wrong. Are two soldiers without munitions better than one with plenty? If so, Lord Shaughnessy is wrong. Is a half-million soldiers, weakly supported by a country of crippled industries, better than half that number vigorously backed by the money and the ample products of a country whose industries are healthy, vigorous, and thoroughly organized? If so, then Lord Shaughnessy is wrong.

But, we believe Lord Shaughnessy is right. Is it not possible, indeed is it not apparent, that undue pressure is being brought to bear to take our valuable men from their regular avocations before they are actually needed? We have many men ready for overseas who have not been called. Why not, at least, divide their time, meanwhile, between industrial and military work? We have actually reached the point where our wheels of commerce are beginning to slow up for lack of man-power—much of which, apparently, is going to waste right around us every day. On all hands we hear the industrial cry for more men. "We can't get sufficient men to fill our orders," they are all saying. And if this is true to-day, what will it be like in another six months or a year, if recruiting goes on under the present haphazard auspices? The answer is all too plain. Our factories will be crippled, our farms will be depleted, our industries of every kind—the backbone of our strength, whether in peace or war— will be driven to the wall.

We shall have a big, unwieldy fighting machine without any "punch."

* * *

We believe Lord Shaughnessy is right, and we believe just as strongly that present recruiting methods are wrong. It is a system that no man defends, a system that no one approves. It evidently exists simply because it existed, and because our Government is so conservative, so unbusinesslike, so evidently unwilling (whether incapable or not, we cannot say) of taking a man's grasp of a man's job. Under the present system of recruiting, the men who answer the call of duty are of course the men who recognize their duty. They are thus the men who count for most at home—the men who can least be spared—the men whose removal causes the biggest rift in our industrial life.

And our Government sits quietly by. Young men, with no ties and no responsibilities and in many cases occupying positions from which they could readily be spared, stand back and allow the ranks to be filled by our artisans, our captains of industry and our professional men. It is this the Government is defending. It is this also Lord Shaughnessy, no doubt, has in mind when he criticizes.

Of course we are going to win this war—why shouldn't we? We are immensely richer both in men and money. But are our enemies going to force us to use all our men and all our money just because we are badly organized? It begins to look that way. Will it then be a victory in which we can take pride in after years—a victory of mere weight of men and superior wealth? Will it even be a victory which we can follow up to advantage? Are we going to allow Germany to issue from this war, as she entered it, the best-organized nation in the world? Will we be ready to meet her competition? Or are we actually going to be too weak from lack of present organization to count in the commercial war that is only just beginning, and which will be fiercer and more prolonged by many times than the present war of men?

What Canada cries out for to-day is organization—for war, present and future. What business man goes on year after year, for example, without taking an inventory? Yet our Government takes no inventory, knows nothing about the stock in hand. Is this business? What Canada needs most urgently at the moment is an inventory of her man resources—the capacity, the responsibility, the experience, the fitness for this or that work, the ties—of every one of her citizens. Next we need an organization that can say to each man, "Your place is—there." What Canada needs is, if you like, moral conscription, which does not curtail the liberties of the citizen in any way, but simply points out in an authoritative way the path of duty. No one would oppose it; few would fail to answer such a call. It would mean the highest conservation of all our resources. It would mean preparedness, not only for this year and next, but for the years which follow. It would mean winning this war without the feeling that Germany, even though crushed, will laugh up her sleeve at the tremendous sacrifices she has forced us to make and at the exhausted condition she has left us in.

Lord Shaughnessy is right when he warns us against impairing our industrial strength. It is a vitally important question—scarcely less important than the war itself, because the two are so closely inter-related. Whatever the outcome of this struggle may be, if we come out of it badly organized, industrially weak, bereft of our most useful men, overcrowded with slackers and incapables, even when we reach Berlin—we've lost.

Canadian Industrial Campaign

The Export Association of Canada Limited, embracing over one hundred of the larger Canadian Manufacturers, is actively engaged in a campaign to create a favorable position in world markets for Canadian industry as a whole. The Association, which has been assisted and encouraged by the Prime Minister of Canada, the Minister of Trade and Commerce, the Canadian Manufacturers Association, the C. P. R., G. T. R., leading representatives of the Press, and many others who recognize to what extent the future welfare of the Dominion depends upon the building up of a sound and profitable export trade, has already opened offices in Montreal; London, Eng.; Auckland, New Zealand; and Melbourne, Australia. Representation is about to be established in South Africa.

Through the connections which it has made for manufacturers, the Association has placed regular shipments for Australia and New Zealand. The Association has been appointed Purchasing Agents in Canada and the United States for the Crown Agents of the Colonies. Important orders are being received from this source. The joint general manager of the Association in London is placing the Association in touch with important buying channels in France, Russia, Italy and Belgium, so that at the conclusion of the war, Canadian firms may have knowledge of the requirements of these markets. The Association is preparing for large business abroad when the scarcity and high rates of ocean tonnage have been overcome.

Cement Bricks

Windsor, Ont., March 21, 1916.

Editor, Contract Record:—

In reference to your article on "Cement Bricks," in the March 15th issue of your valued paper, which is always a welcome visitor to our office, the writer wishes to take advantage of the invitation therein and make a few remarks concerning the same. The writer has had several years experience with all kinds of building materials, especially those made of cement and burned clay, and any remarks made here are based on a knowledge of the facts as found in twenty-six years in the business.

First.—Cement blocks have come to stay; because they afford a cheaper first cost construction than brick—and there will always be those who will use and advocate cheapness regardless of any other or future consideration, or disadvantage.

Second.—Cheapness is the only advantage over a hard-burned clay brick that a cement block possesses. They are neither as dry nor as warm as a brick wall of the same thickness laid with blind headers. In fact you cannot keep iron, steel or leather goods in a cement building without keeping them well packed, unless the walls are lathed and plastered.

Cement concrete has a cold nature and condenses the moisture in the air near it.

Third.—I would think that the greater the pressure applied to a pressed cement brick the better it would be. Although not having any experience with pressed brick I have made enough cement brick for four houses with a machine that tamps them, and we tamped them to the limit to be sure they were solid. In spite of this we found they would stand very little teaming as they wore their corners and faces off. One very bad feature with a cement brick or block is the fact that the least settlement in a wall will cause the cement brick or block to crack straight down, whereas a clay brick wall upon settling will crack along the mortar joints only, making it much easier to remedy.

Fourth.—There is no advantage to the consumer or contractor in a frog brick, except that it is easier for the bricklayer when he has to get down to a tight joint. The bricklayer does not lay the frog down to save mortar. Generally the mortar is spread in such a way that it makes no difference whether the frog is up or down; but in laying the frog down it leaves a level surface on which he spreads his mortar, in that way making it easier to keep to the line. Another feature of the frog, is that the struck side or top side when it is in the mould, dries straighter than the frog side, and when the bricklayer strikes the joint he presses the bottom of the joint back from the face of the brick, in that way leaving that edge exposed to the view as to whether it is straight or not, generally the joint is more nearly straight where frog is laid down.

The frog was placed in the brick, not as most people think, to make the wall stronger, but to save clay in the making and burning less fuel in the kiln. The fact is, that it is much easier to get a frogged brick out of a wall than it is to get a plain brick out; the result being that the plain brick makes the strongest wall, although either will and have met with highest success in all walls for the general building. The clay brick will stand a great deal more heat and pressure than a cement brick.

Very truly yours,
(Signed) William Thompson,
Thompson Bros.

Pure Iron Culverts

Montreal, March 17, 1916.

Editor Contract Record:

We have read with interest the English translation of a paper prepared by Mr. Fraser of Quebec, and read at the Good Roads Congress under the title of "Culverts and Maintenance" and we wish to draw your attention to a common error in translation.

This refers to our Corrugated Pure Iron Culverts. There isn't the slightest doubt that in preparing his paper, Mr. Fraser intended to refer to Pure Iron Culverts, and in the English translation the reference is made to Corrugated Steel Culverts.

Our Company has never sold any Steel Culverts in the province of Quebec, all our product being made from pure iron Toncan Metal, which is nothing more or less than pure iron, from which all the corrosive elements have been practicall eliminated.

Trusting you will publish this correction in as early an issue as possible, we beg to remain,

Yours truly,
The Pedlar People Limited.
(Signed) W. E. Ramsay.

Committees Toronto Branch C.S.C.E.

At a recent meeting of the Executive Committee of the Toronto Branch of the Canadian Society of Civil Engineers, the following members were appointed to the several working committees named below:—

Roads and Pavements.—M. A. Stewart, Chairman; S. G. Talman, G. G. Powell, H. S. Van Scoyoc, W. Huber. Subject—Investigation of sand for concrete highway construction.

General Clauses for Specifications.—Willis Chipman, Chairman; E. W. Oliver, E. L. Cousins, Wm. Cross, D. Molitor. Subject—To consider last year's report and suggest modifications if desirable.

Steel Bridge Specifications.—A. H. Harkness, Chairman; Frank Barber, H. L. Steenbuch, David Molitor, Thos. Taylor. Subject—Steel highway bridge specifications.

Reinforced Concrete.—Peter Gillespie, Chairman; Frank Barber, A. W. Connor.

Sewage Disposal and Sanitation.—A. Macallum, Chairman; P. Gillespie, W. Chipman, F. W. Thorold, J. H. Nevitt. Subject—Report on Commercial Success of treating sewage by aeration.

New Members.—J. R. W. Ambrose, Chairman; H. E. T. Haultain, A. H. Macallum, G. A. McCarthy, J. H. Curzon.

Legislation Committee.—E. W. Oliver, Chairman; J. G. G. Kerry, H. E. T. Haultain.

Track.—E. G. Hewson, Chairman; A. F. Stewart, A. L. Hertzberg, F. B. Goedike. Chairman to choose work to be done by Committee.

Power Plants.—L. M. Arkley, Chairman; A. A. Bowman, Peter Bain, E. T. J. Brandon, F. G. Clark, A. G. Hill, Jas. Milne, A. L. Mudge. Subject—Uniform Steam Boiler Specifications for the Dominion of Canada.

Library Committee.—A. L. Mudge, Chairman; W. A. Hare, A. A. Bowman, Fraser F. Keith.

Hydraulics.—N. R. Gibson, Chairman; T. H. Hogg, H. G. Acres, E. C. H. Dowson, C. L. Fellows, D. Mol Pipe.

Parliament Buildings, Ottawa

Plans for the remodelled Parliament Buildings, Ottawa, have been completed and placed on exhibition to the Members of Parliament in the office of the Minister of Public Works by Messrs. Pearson of Toronto and Marchand of Montreal. Plans and profiles of the interior and exterior are more or less tentative, and have yet to receive the formal endorsation of Parliament.

The main features of the new plans are the preservation of the present architectural scheme of the whole front elevation as it now stands, the tearing down of the new west wing, which was undamaged by fire, but which did not preserve the original architectural harmony of the whole building; the construction of a new rear elevation following the lines of the original architectural scheme, but with a three-storey elevation corresponding to the front; the construction of chambers for the Commons and Senate at the west and east sides respectively, of the building, instead of in the centre, as was the case before the fire; a rearrangement of the office space in the interior, which will give 38 per cent. increased accommodation without sacrificing light or ventilation, and a main entrance hall and Court of Fame extending from the main entrance beneath the central tower clear through to the Library in the rear. This latter wide corridor will give a much more imposing vista on entering, and will afford opportunity for a national gallery of statesmen in oils and in marble or bronze.

The new Commons chamber will occupy practically the whole of the new west wing. It will be considerably larger than the former chamber, being 102 x 63, and providing ample space for some 320 members. The Speaker's chair, instead of being in the centre of the west side as in the old chamber, will be at the north end, and the gallery seating will be much better arranged, both in regard to acoustics and in regard to accommodation for a much larger number of spectators.

The members' lobby and post office will be along the front of the building, with a big lounging and smoking room running along the ground floor on the west side of the Commons chamber. Committee rooms and reading rooms will be situated on each side of the main entrance hall, running from the front entrance back to the Library.

On the Senate side the new chamber will be at the extreme east end, following the same line as the Commons chamber, but somewhat smaller. Fireproof construction and an adequate system of ventilation are being provided for. The plans will be gone over carefully by a committee of the House representing both sides before they are finally approved. It is expected that the work of reconstruction will be begun this spring.

Total imports for the twelve months ending January, 1916, were valued at $502,772,844. This is less than we purchased during the twelve months ending January, 1915, when the total was $603,771,358. For the year ending January, 1914, our purchases were valued at $661,272,527.

Bridge Construction in Ontario

The Evolution of Building Practices—Present Traffic Requirements—Choice of Location and Type—Inspection and Maintenance

By George Hogarth*

There are to-day sections in the south of the province that have been settled for over a hundred years; and in the north, there are vast areas where the axe of the first settler is only now being heard. Bridge construction in Ontario, therefore, varies from the primitive types of timber construction suitable for the lightest of traffic to the more enduring structures of concrete and steel, which are capable of safely sustaining the weight of a twenty-ton road roller.

Conditions in Northern Ontario

Our rivers of the north are usually broad and deep with nothing more secure than a shifting, slippery clay bank upon which to build abutments or piers. The crossing of such rivers is an expensive undertaking, since the river bottom is frequently soft and very liable to be deeply scoured if the current is in any way deflected by a pier. In Ontario a large number of bridges are required each year, and those large structures which are more expensive and serve only a small population must frequently give way to less costly smaller structures or ferries, which furnish communication till bridges are warranted. In deciding on the type of bridge to build, consideration must be given to the lumberman who is bringing sawlogs down the river, and piers must be located or omitted with a view to avoiding log jams. The safe location of the piers usually governs the length of bridge span to use, since the crowding of logs cannot always be prevented, and a heavy jam will often pull timber piers clean out of the river, piles and all. There is also the ice to contend with, and it works almost unceasingly to destroy any timber structure with which it comes in contact. Late in the fall, when the water is low in the river, the ice forms and sticks solidly to the piles or cribs for a depth of probably three to four feet. Should a sudden thaw come in February, the water lifts the ice and gives the piles a heave that throws the entire structure out of grade. For these reasons, it has been found advisable to bridge the rivers with one span wherever possible, and to place the abutments or piers out on the banks of the stream. The placing of piers in the river channel is usually an expensive piece of work, and the maintenance money that must be spent to protect them from logs and ice in the spring of the year is frequently considerable. The use of long span bridges is often therefore an economy.

Building Materials

There is very little gravel or rock to be found in some sections of Northern Ontario, and concrete abutments or floors cannot be considered. Practically everywhere, though, there is standing timber of fair size and quality which can be quickly cut into piles and roughly hewn to form portions of the piers and flooring. The design of structure has thus developed along the most economical lines, and to-day, you will see on the highways of the north steel bridges resting on timber piers and having a sawn or hewn plank floor. On the smaller creeks and rivers, the timber Queen Post bridge is still built, and is supported by pile piers or timber rock filled cribs; but where the bridge must be 60 feet or over in length, a steel span is the best and cheapest type of structure that can be built. The cost of labor in remote sections of the north is sometimes out of all proportion to the work done, and these types of construction have been developed from actual experience as being the most economical under present conditions. With such a type of bridge, the building of the pile piers requires comparatively little work, and four or five men and a team will finish the timber work, erect the steel span and lay the floor of an ordinary structure in about three weeks' time. Many such bridges are built in locations which are 25 and 30 miles from a railroad, and local men accustomed to the country must be employed, since the ordinary discouragements of life on that class of work drive the newcomer out of the business.

Bridge to Meet Traffic Conditions

The traffic on some of the newer roads of the north does not warrant an expensive bridge across a broad river, and in such a case a wire rope is stretched from bank to bank and a scow provided, by means of which travellers may ferry themselves across the stream. Such a contrivance is cheap and is of great use during the summer months of the year, but the crossing will be impassable to all ordinary travel for a week or so during the spring and fall.

The highway bridges built in the settled districts and counties of older Ontario are of a more advanced type of construction. They must be capable of carrying heavier loads and be built so as to withstand the wear and tear of greater traffic. Since good sand, gravel, and crushed stone are easily obtained and cement is cheap, it is economical to build the structures of concrete. For the longer spans where concrete is not as serviceable, the steel bridge is used, and it is customarily supported on concrete abutments and provided with a concrete floor.

Type of Bridge

For short spans, the concrete beam bridge is a very desirable structure, and for spans of medium length, where local conditions admit of its use, the concrete arch is of pleasing appearance. Such work, when well designed and properly built, is very durable, but great attention must be given to the foundations and to the surrounding conditions in order that damage to the structure may be prevented. Concrete is easily adapted to almost any foundation, but it is not in the best interests of such construction to use it in important locations where settlement of the piers is to be anticipated, or where the river channel will be cramped, due to a low bridge being required. The safety and enduring qualities of a concrete structure depend to a great extent on the stability of the foundations. The slightest movement of the footings will result in cracks opening in different parts of the structure, and while such cracks may not seriously affect the strength or safety of the bridge, they are unsightly and indicate an undesirable condition of affairs. Concrete is a splendid building material and will give good results even with very indifferent workmanship. It is particularly well adapted to certain locations and designs,

*Chief Engineer, Ontario Highways Department. Before Good Roads Congress, Montreal.

but if used indiscriminately failures are bound to occur. In the case of small concrete bridges, the placing of the footings at a sufficient depth below the ground or water surface is frequently disregarded. As a result, the rush of water during a freshet undermines the foundations and the entire structure may be lost. It is good practice to carry all footings down to a depth of at least four feet below low water level since at that depth the foundation will be safe from frost, as well as from the scouring action of the water. There are so many vital considerations entering into the design of a highway bridge that the selection of the type and nature of the bridge should be left entirely to the engineer and his decision should be final.

Heavier Riveted Construction

Within the last fifteen years there has been a gradual development and improvement in the general design and construction of steel bridges. The tendency has been toward strong and rigid riveted construction, and the light types formerly built have been abandoned. This progress is best illustrated in the cities by the use of heavy plate girders, and in the country by the building of fully riveted bridges in place of the pin-connected structures formerly erected. With riveted details, a longer life is to be expected of such bridges. There is still, however, room for further improvement in the design of typical connections, but the overcoming of prejudice against new methods along such lines is a slow process. Details that were considered good design twenty years ago, but which are now obsolete, may be used in structures built to-day, if care is not exercised in checking the plans. Our highway bridges are now designed to carry a concrete floor and a 15 or 20-ton road roller, or a live load of 100 pounds to the square foot of floor surface. The structure which is built to carry such loading is of good proportions with fairly stout members. In the past, insufficient quantities of metal were used in many bridges, and they were built so light as to be unable to sustain for many years the wear and tear to which they were subjected by the traffic and the elements.

Maximum Load

The tendency of the times indicates that a 20-ton road roller will be the maximum load for bridges for some time to come. In some localities it is proposed to limit the weight of road rollers and auto trucks allowed to pass over highways and to make the maximum permissible weight of such machines ten or twelve tons. Legislation along such lines appears to be advisable, since with an unrestricted weight of auto trucks we would soon see excessively heavy vehicles doing considerable damage to highway bridges. Some timber and concrete floors have already received severe treatment and have been partly destroyed by the heavy rear axle weight of loaded trucks, and unless steps are taken to curtail such weight the damage will greatly increase. It is advisable, therefore, to enact laws which will set a limit on these heavy loads so that the highway bridges can be built in the security of knowing the heaviest load they will be called upon to carry. Otherwise, great confusion may result, and a condition might arise where all our bridges would be too weak the moment an auto truck manufacturer increased the capacity and weight of his product. The establishing of a definite maximum load gives the auto builder and the bridge engineer a basis upon which to develop and improve all designs.

While we now build what is believed to be a fairly stout bridge, the required minimum thickness of metal of 5/16 inch causes nearly all highway bridge work to be known as tinwork in the shop where it is fabricated. If durable structures are to be constructed, no skimping or trimming out of metal should be allowed. It would appear to be a step in the right direction if no metal less than 3/8 inch thick was permitted to go into a highway bridge. Steel highway bridges are still built too light and flimsy to give a long length of life. Many steel bridges in use 25 years urgently require renewal to-day because of the serious rusting of the thin material, and if our work is to be enduring and have a fair length of life, it is absolutely essential that a sufficient quantity of metal be used in the new bridge.

Flooring

There are several types of flooring used on highway bridges built to-day, and probably the one most frequently placed and which gives good satisfaction is the reinforced concrete floor. The plank floor and the creosoted wood block floor are also used in cases where concrete materials cannot be had, or where it is desired to lighten the dead load on a long bridge. In laying a concrete floor, too much care cannot be exercised to see that all stone, sand, or gravel is clean and the best to be obtained, since otherwise the result will be a poor concrete which will soon show signs of wear and disintegration.

The office methods and specification data used in the design of bridges call for little or no comment, but many of the methods of obtaining first hand information in the field during the original survey or inspection of the site of the bridge, might be profitably revised. Inexperienced men should not be sent to measure up the location of a proposed bridge. Each crossing of a river is surrounded by widely different conditions, and an engineer well versed in building and maintaining bridges should make the original surveys and examinations.

History of Location

When a bridge is to be built, accurate information is required respecting the width of the river, the depth of the water, the height of high and low water, the navigation or log driving to be provided for, the manner in which the ice goes out in the spring, the quantity of driftwood brought down by the freshet, the nature of the banks of the river, the character of the foundations that will be required, the local material available for concrete or timber work, and the distance to the nearest railway station. This information is necessary, be the bridge small or large, and in addition the judgment of the engineer comes into play when the question is put as to what structure is best adapted to the site. Many instances could be cited where, owing to incomplete information, a bridge pier was placed in the middle of a river. The amount of money required to protect and maintain that pier, together with its first cost, would have paid for a steel bridge long enough to completely span the river. In some cases, bridges of insufficient length have been placed at crossings of wide rivers, and as a result they have been swept away on the crest of the first serious flood. The position of the banks of a river is very significant. They are standing evidence that, at one time or another, the river possessed sufficient force and power to sweep away everything between those banks, and a structure which cramps that wide waterway is putting up a losing fight with nature. The pages of our engineering journals continually record the washing away of bridges, and the lesson frequently placed before us is that the waterways provided at bridges should be of a sufficient size to pass the floods. The creek of to-day may be the roaring torrent of to-morrow, and provision should be made for that excessive rush of water. It is only natural to build bridges as small as possible, and to construct them with the least expenditure of money, but in building a bridge the first consideration should be the safety of the completed structure and the size of the waterway to be provided must govern the design.

Foundations

The nature of the foundation on which the abutment of a bridge is to be placed deserves mention. An engineer is called upon to construct bridge footings in every kind of location from one that is a bottomless bog to one that is splendid solid rock. There are between those extremes a number of different classes of material, all of which require close attention in order that a secure footing may be obtained. A solid rock foundation is ready for the concrete as soon as all the loose and decayed rock has been blasted and cleaned away. It is well to have the rock footing fairly level and yet rough enough to give the concrete a good bond to prevent any possibility of sliding. With a foundation of gravel, boulders, or hardpan, the concrete of the footing may be deposited when the excavation reaches a depth of four or five feet, since at that depth scouring of the material cannot occur and frost will have no effect.

Use of Piles

Where the foundation is sand, silt, muck, or soft clay, the bottom will require that piles be driven, and soundings should be made to ascertain the depth or length of pile required to bring up against hard material. In driving piles, good judgment and experience is required to know just when a pile is sufficiently driven. Many specifications require that driving shall be continued to refusal, and this is much to be preferred to under driving. The preparation of a pile foundation requires just as much care as any other part of the design of a bridge, since with improper or insufficient driving settlement will occur and the abutment or pier will be destroyed.

In some locations where an exceptionally soft foundation occurs, it is advisable to divert the road to a better crossing, where a more secure bottom can be obtained. With a highway bridge, however, there is a lack of vibration and impact and the loading is comparatively light, so that in almost all soft locations a good pile footing will be found to be all that is required to safely carry the abutment.

For short bridges up to, say, 40 or 45 feet in length, and where the bottom is soft, a steel beam bridge gives a very satisfactory structure. The small cost of the entire work does not justify expensive pile foundations, and a mat composed of long timbers may be laid in the bed of the river so that each timber extends under both abutments. A slight settlement is to be expected with such a structure, but no harm or damage to the bridge will occur.

Maintenance of Bridges

The maintaining of the many steel bridges now on the highways is a work requiring considerable experience and attention. A bridge is like any other structure built by man, it is not everlasting. In the case of steel structures, it has practically been a custom to neglect them and they are seldom painted. This neglect hastens the rusting and decay of the metal, and the day soon comes when another bridge is necessary. It is frequently a difficult matter to have councils appropriate money for painting bridges when they have seen indifferent and expensive work done on bridges in their own or in an adjoining municipality. There is no doubt whatever that money spent for painting is real economy, and there is no defense that can be offered for allowing a bridge to go to ruin. If a structure is painted every four years, it will take five complete paintings to protect it for 20 or 25 years, and at the end of that time it should be in a good state of preservation. It could then be removed to a highway having lighter traffic and would probably be of good service in that new location for a number of years. Experience with bridges that have been uncared for for 25 years, indicates that they are just about ready for the scrap heap, whereas a proper painting carried out at comparatively small cost would have rendered them still useful for an indefinite period.

Inspection

A competent inspector should examine all bridges at least twice a year. The inspections should be in the spring and fall, and every portion of the structure should be examined to discover any defects. The older bridges have many welded members, and experience has shown that such details are liable to fail while in service. Where there are two bars in a member and one breaks there is still sufficient strength available to carry the structure, pending immediate repairs, but no chances should be taken, and if there is any doubt as to the ability of the structure to stand up it should be closed till repairs can be completed. Notice boards calling attention to a speed limit on the bridge may be in place, but are, in all probability, illegible, due to disappearance of the paint. Such boards are still necessary. They should be painted with easily read type and placed conspicuously in order to obtain compliance with the stated request. The fact that a notice board cannot be read usually results in a lack of observance of a very necessary restriction on the speed of horses crossing a bridge.

Repairs

The practical test of observing the bridge during the passage of a heavy load may result in the discovery that the various parts appear to be loose and that the entire structure appears to be working or moving. If there are a number of adjustable members in the trusses and lower laterals, it is probable that the tightening of such while no load is on the structure will cure any apparent looseness, while if the bridge is fully riveted it is desirable that close attention be given the various joints to see that rivets are still tight. If a number of loose rivets are found, it is best to cut them out and re-drive so as to produce a tight joint.

In Ontario we have many concrete bridges, and where such structures were originally well built there are no maintenance charges and little or no inspection required. The first concrete arch bridge built by the Department of Public Works was constructed in 1907. It is founded on solid rock, and to date not one cent has been expended for maintenance.

In conclusion it may be said that the highway bridge is to-day in an important stage of development. The knowledge gained in using the various materials of construction is tending to modify and improve the design and general appearance of such structures, and a more artistic type is being aimed at. With an established system of loads for all structures, and a greater public demand for permanency in construction, a considerable improvement in the character and type of bridges is to be expected.

Concrete Foundations for Asphalt Pavements and Roads Subject to Heavy Travel

By Clifford Richardson*

The first essential in road construction of a permanent character is a dry and firm subsoil upon which to build. This being assured, another and more essential factor in the satisfactory construction of the highest type of asphalt pavement, country highways, and, in fact, for all forms of road surfaces to carry heavy traffic, is a suitable foundation. This is emphasized by the weights which our main arteries of communication are called upon to sustain owing to the advent of the motor vehicle, more especially the motor truck, the latter rapidly increasing in capacity to such an extent that means of regulating its use are being considered. Portland cement will, therefore, find an extended use as travel on our roads increases, for the purpose of affording adequate support for any type of surface. The only satisfactory substitute therefor has been found to be an old, well-compacted broken stone road which, in this country, is not often available, but of which good examples are found in England.

Foundation Supports the Load

In the case of asphalt surfaces, these, in themselves, possess no inherent strength to support heavy loads and, like all other surfaces, require an adequate support when subjected to concentrated travel. Whatever type of pavement or road surface, of a character to carry heavy travel, may be selected, it must, unquestionably, be given such support by a proper foundation, and this can be accomplished in no more satisfactory way than by a suitable Portland cement concrete. While this has been recognized for some years, in certain instances, it is plain that it must have a general acceptance in the near future, at least as applied to our main arteries of communication, while it is generally desirable as a matter of permanence, where funds are available, in view of the much longer life which any form of construction will have if placed thereon. The primary difficulty is, of course, the availability of funds for this purpose. As a well constructed Portland cement foundation needs no maintenance its cost may be met by the issue of long term bonds. Such a procedure would violate all principles of economics as applied to the surface itself, the life of which, for any type, cannot be such as to justify a bond issue for a longer period than ten years.

Thickness of Concrete

The thickness of concrete which is called for as an adequate support for a road or street is, of course, dependent upon the character of the travel it will be called upon to carry and upon the support which it receives from the sub-soil on which it is placed. In London, England, on one of the streets of the heaviest traffic, High Holborn, it has been proposed to place 11 inches as being a thickness necessary for the conditions to be met there. The usual thickness in this country for our most important thoroughfare has been six inches, but with the enormous disturbance which is continually going on for underground operations and with the increasing weight of the motor truck this will, in the near future, have to be increased in proportion.

At the same time, it is becoming recognized, at least by experts, that there must be a great improvement in the methods employed in the selection of the aggregate, especially the sand, of which concrete is made. Testing the sand is as important as testing the cement if work of the highest character is expected. It has also been demonstrated that one brand of cement will give more satisfactory results with one sand than with another, although each cement will yield the same results with standard sand. It is evident, therefore, that there is a great opportunity for improvement in the character of concrete and it is encouraging to know that the United States Office of Public Roads and Rural Engineering and several specialists on the subject are making extended investigations in this direction.

Permanent Investments

A Portland cement concrete foundation may be looked upon as a permanent investment and, to a certain extent, concrete road surfaces may be also considered in the same way, as when they become too rough with age to be used as such they will, with adequate repairs, become available as a foundation for an asphalt surface or one of some other type.

California, under the policy pursued by its State Highway Commission, is expending millions of dollars in the use of Portland cement concrete for highways, and looks upon this expenditure as an asset for many years. Upon this concrete an asphaltic surface, composed of sand and fine pea-grit, is laid for the purpose of obtaining one which is more agreeable for travel at a cost of but 8 cents per square yard. This is a temporary expedient where the travel is light and funds are not available for a more suitable form of construction. It is expected to last for three or four years and give an adequate return for the money expended. Where travel is more concentrated, an asphalt surface mixture containing fine stone is employed, costing about 50 cents per square yard, which may be looked upon as having a higher degree of durability. Probably there is no State where as satisfactory a combination of Portland cement concrete and bitumen has been used, looked at from the point of view of economics, as in California, although it may be regarded as too thin, having a thickness of only 4½ inches. This is, of course, due in part to the favorable climatic conditions which the form of construction employed there is called upon to meet.

It is worthy of note that where Portland cement concrete is protected by a bituminous or other form of surface, a much smaller proportion of the hydraulic binding material and a lean concrete is called for, than where it is exposed to travel and is, consequently, much less expensive.

Careless Mixing and Placing

Experience has shown that our present methods of mixing and placing concrete for road construction may be improved to a very large extent. Too much work of this description is carried out carelessly, without a proper study of the mineral aggregate of which the concrete is composed and without devoting sufficient time to its thorough mixture, but engineers are awakening to their shortcomings in this respect and there

* Before American Concrete Institute, Chicago.

will no doubt be a great improvement in this direction in the future.

Of course, the characteristics of the Portland cement in use in concrete foundations for road surfaces and the degree of fineness to which it is ground, form an element of great importance in the success with which concrete is employed for any purpose, although it is recognized that the product of our American industry is generally of a very high quality.

Climatic Conditions

Climatic conditions and the great extremes of temperature, at times ranging from 130 degs. F. to 40 degs. F. below zero, result in the formation of cracks in Portland cement concrete when used as monolithic foundations for asphalt surfaces, and these are often reproduced in the surfaces themselves, but the effect of such cracks usually disappears within the first few years of the life of the surface and are not subsequently manifested to any disagreeable extent. That these cracks are largely due to contraction, due to extreme temperatures, is demonstrated by the fact that they are far less apparent in such a climate as that of California where extreme temperatures do not occur. In certain instances expansion of Portland cement concrete, at joints between different day's work, have been observed, but this happens but rarely and, again, is not manifested after the expiration of a few years' time.

Progress Report on Nova Scotia Water Power Investigations—Establishment of Meteorological Stations

By K. H. Smith*

PROBABLY more small water power developments, such as saw mills, grist mills, and carding mills, have existed in Nova Scotia than in any other part of Canada. However, in common with all other countries, before the advent of long-distance electrical transmission, interest in water powers was purely local until the year 1909, when public interest in water powers was sufficiently aroused to influence legislation. Previous to 1910 no reservations had been made of the waters of the beds of rivers or lakes comprised within land grants. Moreover, by that time the greater part of the public domain had passed into private hands.

In the meantime the activities of the Hydro-Electric Power Commission of the province of Ontario, as well as those of private concerns in other parts of the country, did not go unnoticed in Nova Scotia, and in 1909 an act was passed indicating that public interest was alive at least to that particular phase of the possibilities of utilizing hydro-electric energy in Nova Scotia. A culmination of public discussion and interest in hydro-electric energy so far as Nova Scotia is concerned seems to have occurred during the 1914 session of the local House of Assembly.

Appointment of Commission

The consideration of bills passed at that session led to considerable discussion along general hydro-electric lines, and the concensus of opinion seemed to be that something should be done in Nova Scotia to determine whether or not a hydro-electric policy similar to that carried out in Ontario by the Hydro-Electric Power Commission could be inaugurated to good advantage in Nova Scotia. Accordingly an Act was passed in the latter part of the session which provided for the appointment of a Nova Scotia Power Commission to make certain investigations and recommendations.

The Commission was organized in accordance with the Act, and met on July 31, 1914. Following several conferences between officials of the Dominion Water Power Branch and representatives of the Commission, a co-operative agreement was reached. The Commission was to have the services of an engineer of the Dominion Water Power Branch, with his expenses and necessary field equipment, while the Commission was to make available the sum of $3,000 for the first year's work. The writer, K. H. Smith, as engineer of the Dominion Water Power Branch, was instructed to proceed to Halifax as resident engineer in charge of all work to be undertaken.

Conferences were held in Halifax on April 20 and 21, 1915, between Mr. J. T. Johnson, chief hydraulic engineer of the Dominion Water Power Branch, the resident engineer, and the members of the Commission. Active work was begun on May 10, 1915, when gauging stations were established on some of the rivers, and since then both field and office work has progressed without interruption.

Available Power

It is apparent that an adequate estimate of the water power possibilities of any stream depends mainly on two things; first, the head or fall available; second, the amount of water available. The amount of water available may be influenced by the possibility of storing flood flows to increase the low water flow. The first factor, that is, the head or fall, as also the question of storage in lakes or artificial basins, is constant, and may be determined absolutely by instrumental surveys. The second factor, that of the amount of water available, is variable, and depends entirely on the rainfall, the amount of water which runs off in the streams being further influenced by local conditions of temperature, wind, geological formation and vegetation. A gauge is installed at a suitable location, indicating the height of the surface of the water at its various stages. By means of an instrument, known as a current meter, registering its revolutions electrically, the velocity and depth of the water is obtained, at various stages of the stream as indicated by the gauge. Having determined the area of the cross-section of the stream and the velocity of the water, the volume of the water flowing at each of these stages can therefore be computed by a simple multiplication of these two factors and this result or "run-off" is usually indicated in cubic feet per second or as it is frequently abbreviated, "second-feet." By tabulating in a special way a relatively small number of these measurements, distributed from low water to high water, the amount of water flowing in the river may be determined for all stages, by merely reading the gauge. For this purpose, local observers are employed at small expense, who read the gauges on the various streams, usually once a day and more often at special seasons.

* Resident Engineer Dominion Water Power Branch, Halifax.

The amount of rainfall is measured in a cylindrical vessel suitably located, and requires attention from an observer at each period of rainfall.

Gauging Stations

So far as possible, gauging stations are established not only on representative streams in the district, but also on streams which are of themselves important. At most of these stations daily gauge heights are obtained with additional records at critical periods of flow. In one or two cases, records twice a day are obtained. In addition to this all the larger water power developments of the province with one or two exceptions, and including all pulp mills and all hydro-electric plans supplying various municipalities throughout the province have been personally examined. From every possible source data with respect to existing water power developments is being collected and tabulated. Considerable progress has been made in this work. A rough reconnaissance has been made of nearly every part of the province, in order that the detail work might be more intelligently distributed. A small map is appended showing approximately the locations of all precipitation and stream gauging stations.

Satisfactory Progress

It is thought that with the exception of the island of Cape Breton, representative stream flow statistics are being obtained throughout the whole province. The present system of stream flow recording stations should, however, be considered merely as a framework with many parts to be more completely filled in as time and funds permit. Several additional stream gauging stations will be established during the immediate future under arrangements with the Meterological Service, or by means of voluntary observers already available. Funds will also probably be available for one or two additional paid observers.

A report will be prepared for the Dominion Water Power Branch covering the work accomplished to the end of March 31st, 1916. This will contain complete and detailed information of stream flow available to that date. It will also include detailed reports on the power possibilities of a number of streams, which reports will be as complete and comprehensive as data available to that date will permit. It is believed that in the beginning that has been made, foundations have been laid for satisfactorily carrying the work to completion, and it is hoped that arrangements will be made whereby the present run-off and power studies will be continued until the entire province has been systematically covered and its water power resources conclusively determined.

New Union Station, Toronto

Satisfactory progress is being made on the new Union Station, Toronto. The excavations for the foundations have been completed, and the concrete caissons and piers have been entirely installed. Machine rooms, furnace rooms, boiler rooms, etc., have been excavated, and the east and west wings are ready for steel. The centre section will be completed and ready for steel in about two weeks.

The foundation work was done by Peter Lyall & Sons, the general contractors. All foundations were carried down to bedrock; there are no clay-bearing foundations in the whole plan. In excavating, water was encountered in practically all the foundations, due to the proximity of the site to the lake. These were kept dry by the use of pumps and siphons. Service tracks for superstructure erection are already laid, and some of the structural steel and the erection derricks are already on the ground. Setting the steel bedplates is expected to commence on April 1, and the erection of the structural steel about April 20.

New York a Gilded Tragedy

(Sydney Brooks in North American Review)

To come from England to Manhattan Island, from a country strung up as never before in its annals to the heroic pitch, full of the spirit of sacrifice and endurance and in daily touch with the grimmest facts of life and death—to come from such a country and to land in New York is to make a change indeed. For New York, always a feverish and pleasure-loving city, is to-day simply drunk with money. Even during the height of the steel boom of twelve or thirteen years ago, when every train from the west seemed to bring fresh carloads of brand new millionaires, the metropolis was not so openly reeling with dollars as it is at this moment, when the gayest "season" of its history is drawing to a close.

It almost appals an Englishman to find there in full swing the old rotten life that we in England have put completely behind us. And it appals him still more to reflect that a bare two years ago he was leading, if one allows for the extra intensity that New York throws into all its activities, very much the same life himself. One despairs of ever being able to convey to one's American friends how completely the war and its conditions and consequences has become not merely a part of, or a side issue to, but literally the whole British existence. They are so dominant, have so utterly swallowed up everything else, that no other form of life, least of all the trivial carelessness of peace, seems normal or even credible.

I catch myself in New York, if I enter a lighted room, instinctively reaching out to draw down the blinds lest a Zeppelin raider should note the glare; and of all the sights that crowd in upon me, that of multitudes of young men who are not in khaki strikes me as the strangest and the most repellent. It may be one more proof of our demented state, but it is the bare fact that not for anything would we in England change places with you in America or part with the waste and misery of the war to receive in return the "blessings" of such a peace as yours. Stay-at-home Americans simply cannot enter into or even conceive the atmosphere of the belligerent nations in this struggle; and conversely, so long as it lasts, a visitor from any one of the countries at war will continue to be shocked by the atmosphere of America as something unnatural to the point of being grotesque.

In New York the fact and the vastness of this chasm of sentiment assail the visitor with the sharp finality of a bayonet thrust. Louvain and Rheims are among the stricken victims of the war, but New York is its supreme and gilded tragedy, and has, I fear, neither the sense nor the soul to know it. Americans must by now have heard of the English charwoman whose husband was at the front and who was drawing her weekly separation allowance. She was asked what she thought of the war.

"What!" she replied. "A pound a week and no 'usband! Why, it's 'eaven! It's too good to last!"

There is something in New York's attitude towards the war which reminds one of this simple soul.

Ammonia in the Chlorination of Water—Effect of Color, Turbidity and Temperature

By Capt. J. Race*

In the course of some experiments on the effect of color, turbidity, and temperature on the chlorination of water, the author thought it would be interesting to determine the relative efficiencies of various hypochlorites. Nothing worthy of mention was observed until ammonium hypochlorite was used; this was prepared in solution by the double decomposition of calcium hypochlorite and ammonium oxalate, and great care was exercised to prevent the addition of an excess of oxalate, which, if present, would introduce a factor of unknown value. It was anticipated that the reaction would proceed somewhat along the lines represented by the following equation:

$$Ca(OCl)_2 + (NH_4)_2C_2O_4 = CaC_2O_4 + 2NH_4OCl$$

calcium hypochlorite, ammonium oxalate, calcium oxalate, ammonium hypochlorite

The calcium oxalate was deposited by centrifuging at a high speed and the supernatant liquid removed for experimental work.

In testing the effect of this solution on a culture of B. coli communior seeded into raw Ottawa River water, the author was very surprised to find that the germicidal value was very much in excess of the hypochlorites of calcium, sodium and potassium. The velocity of the reaction as calculated by the formula

$$K = \frac{\log \frac{N_1}{N_2}}{t_2 - t_1}$$

in which N_1 represents the number of organisms at t_1, and N_2 at t_2, showed that, with 0.3 parts per million of available chlorine in each instance, the value of K for ammonium hypochlorite was twenty to thirty times as great as that of calcium hypochlorite. This experiment was confirmed by others, which gave similar results.

In searching for an explanation of this phenomenon it occurred to the author that it was probable that ammonium hypochlorite was exceedingly unstable in dilute solution, and spontaneously decomposed into chloramine and water, as represented by the following equation:—

$$NH_4OCl = NH_2Cl + H_2O$$

ammonium hypochlorite, chloramine, water

Chloramine has been shown by Rideal (Journal of the Royal Sanitary Institute, 1910, 31, 33-45) to have a much greater germicidal action than an equivalent of chlorine. Rideal deduced this fact from experiments on the chlorination of sewage, in which he found that "the first rapid consumption of chlorine or hypochlorite was succeeded by a slow action which continued for some hours—even days— and was attended by a germicidal power after free chlorine or hypochlorite had disappeared. . . . " "It became evident that chlorine, in supplement to its oxidising action, which had been exhausted, was acting by substitution for hydrogen in ammonia and organic compounds, yielding products more or less germicidal." Rideal supported this by determining the carbolic coefficients of hypochlorite, and of hypochlorite with the addition of an equivalent of ammonia; these gave values of 2.18 and 6.36 respectively. Although Rideal seems to have made this experiment merely for the purpose of explaining an observed phenomenon, it is curious that the possibilities of its practical application to water and sewage disinfection seem to have either been entirely overlooked or discarded on account of economic considerations.

Ammonia Content

After noting the above-mentioned facts in connection with ammonium hypochlorite, the author followed up Rideal's work and produced dilute solutions of chloramine by the addition of ammonia to calcium hypochlorite solutions. These had the same germicidal power as the chloramine produced by double decomposition, and were approximately three times as efficient as an equal quantity of hypochlorite.

The next step was to determine the relative proportions of hypochlorite and ammonia that would yield the greatest efficiency. The results obtained, though not entirely conclusive as to the most efficient ratio, showed that an increase in the ammonia beyond an equivalent of the chlorine (available chlorine: ammonia as $NH_3 = 2:1$ by weight) did not produce results commensurate with the increase of ammonia. Half an equivalent of ammonia, or chlorine: ammonia $= 4:1$ gave inferior results, but the reduction in efficiency was very much smaller than the reduction in the ammonia. The relative proportions of chlorine and ammonia must also be considered from the economic standpoint, and when this process is carried out on a large scale these various considerations will demand a rather fine adjustment.

A remarkable feature of the treatment of water with a mixture of hypochlorite and ammonia is the almost entire absence of absorption. On adding bleach to the Ottawa River water, so as to produce a mixture containing 10 parts per 1,000,000 of available chlorine, about 35 per cent. is absorbed in five minutes at 60 deg. Fahr., and 60 per cent. within one hour. If an equivalent of amounts is first added to the bleach, only 1.4 per cent. of the available chlorine is absorbed in one hour and 3.2 per cent. in twenty hours. As there is practically no absorption of the germicidal agent, the longer the contact period the better will be the results obtained. For instantaneous sterilisation, the relative efficiency ratio of 3:1 for the mixture of chlorine and ammonia as compared with chlorine cannot be obtained, but with increase of contact period the efficiency ratio also increases, and after about forty minutes the ratio becomes greater 3:1. The germicidal action of the mixture continues to persist on account of non-absorption, and for a comparatively long time, and as a consequence of this, no after-growths are produced.

Cost

Basing the calculations on a ratio of one equivalent of ammonia to one equivalent of avaliable chlorine (0.5 part per 1,000,000 NH_3 to 1.0 p.p.m. available chlorine), a very conservative estimate of the most efficient ratio, this process becomes economical when the price of hypochlorite exceeds $2.00 per 100 lb.

* Canadian Army Hydrological Corps, in "Surveyor."

This statement is based on the mixture produced being three times as efficient as hypochlorite; that 33 per cent. of available chlorine can be obtained from bleach, and that ammonia can be purchased for 1s. per lb. The efficiency ratios of 3:1 can be obtained under the conditions of chlorination usually found, and no alteration in the point of application will be required. Bleach containing more than 33 per cent. of available chlorine can be obtained, but very few plants actually extract more than this amount, as there are certain losses which are unavoidable. The present price of ammonia aqua. 16 deg. B, is quoted in the U. S. A. at 2¼ to 2½ cents per lb. This solution contains 10.3 per cent. of NH_3, and the anhydrous ammonia is therefore worth 22 to 25 cents—or approximately 1s. per lb. In Ottawa, bleach can be obtained for $3.50 per 100 lb., and, by the adoption of the ammonia process, the heavy dosage of 1 part per 1,000,000 of available chlorine required to treat the Ottawa River water (color, 40 p.p.m., platinum scale) can be reduced to 0.33 p.p.m., with a saving of about $6.70 per day, or $2,400.00 per annum, if the laboratory results can be duplicated under service conditions. In the United States, where much higher prices prevail for bleach, the advantage to be gained by the substitution of the ammonia process is, of course, even greater.

Aesthetic Consideration

For some years it has been considered as at least probable that the fishy odor and taste of heavily chlorinated water was caused, not by the chlorine or hypochlorite, but by substituted nitrogenous compounds. At first sight it would appear that by the addition of the substituted nitrogenous compounds contained in the ammonia mixture this objection would be accentuated and deprive the process of its practical value. In practice no such result is obtained, and no trace of the added mixture can be detected. As the total amount of chlorine added to the water is only about one-third of the usual dosage, the total amount of chlorine compounds, nitrogenous and otherwise, is only one-third also, and complaints regarding taste and odor should be reduced, and not increased, by the adoption of the new process, unless the compounds produced are totally different in the two cases.

Since writing the above the author has applied the above process to a small plant treating 200,000 Imperial gallons per day, and has met with unexpected difficulties. When a 10 per cent solution of bleach was made and strong ammonia (0.880) added, a rapid loss of available chlorine resulted. This was reduced considerably by diluting the hypochlorite solution before adding the ammonia, but even then the results were not satisfactory. Laboratory experiments confirmed the loss produced by mixing comparatively concentrated solutions, and also that the loss could be obviated by immediate dilution with large volumes of water. The arrangements in the experimental plant are now being altered so that the ammonia and hypochlorite will only mix for a few seconds before dilution with the raw water in the intake pipe.

Although various details have yet to be worked out, these notes are published in the hope that others will take up this work and endeavor to work out a process that will give some relief from the present exorbitant price of hypochlorite.

High Level Air Lift Pump at Quebec Bridge Discharges 5,000 Gallons per Hour Against a Head of 500 ft.

THE interesting air lift plant here to be described has been installed for supplying the Transcontinental Railway yards at the Quebec Bridge. The neighborhood of the magnificent St. Lawrence would seem to be an anomalous location, but several considerations operated to determine the installation. The rise and fall of the tide, the height of the embankment and the unsuitability of the river water were important points, and besides this the use of the river water would have necessitated the construction of a pumping plant at a distance from the power house, and would have increased the cost of attendance.

Work was started in September, 1912. Forty-three feet of 8 in. wrought iron pipe was driven from the surface to the rock, and from that point a 5-in. bore hole was started. The well was drilled entirely in shale, red and gray alternating.

On September 30th a depth of 400 ft. had been reached, and a rough pumping test yielded 200 imp. gal. per hour. At 280, 520 and 700 ft., respectively, dry crevices were encountered, while at 775 feet water was struck in considerable quantity. The hole was then reamed to a diameter of 8-in., and a subsequent test yielded 3,200 imp. gal. per hour.

At a depth of 980 ft. another water crevice was opened up and at a depth of 1,012 ft. drilling was discontinued. The whole well was then reamed out to 8-in. diameter. A large plunger pump was used for a 24-hour test, and with 400 ft. of rods in the well a yield of 5,400 imp. gal. per hour was maintained. This pump was afterwards operated for eight days to clean out the well, and a sample of water was analyzed and reported satisfactory for both boiler and domestic purposes.

When the well is not being pumped water rises to the surface; when being pumped to capacity it drops, however, to a depth of 400 ft. from the surface.

A joint contract was awarded to Canadian Ingersoll-Rand Co., Limited, and Williams and Wilson, Limited, of Montreal, for furnishing and installing a suitable pumping plant. The air-lift system was adopted owing to its numerous advantages over other systems of deep-well pumping, as with this system there are no moving or wearing parts in the water, and the air-compressor may be located at any distance from the well.

In lowering the pipes and foot-piece, which were extra heavy, great care was required because of the weight; but there was no mishap of any kind.

The air-compressor is a Canadian Ingersoll-Rand tandem compound steam-driven machine, designed for a terminal pressure of 250 pounds, and the air cylinders are fitted with a new type of valve known as the circo-leaf valve, which is absolutely noiseless in operation. The frame is fully enclosed, and the moving parts work in a constant flood of oil. A combined speed and pressure governor controls the compressor.

The air-lift foot-piece was manufactured by the

* Compressed Air.

Harris Air Pump Co., of Indianapolis, whose pumps are extensively installed throughout Canada. The column of water is carried by an air-jet situated below a choker, which arrangement eliminates slippage and causes the air to be distributed through the water in small bubbles. The booster pump was also furnished by the same firm.

Water is discharged into a steel tank 24 ft. in diameter, and the total capacity, including the leg, is 61,170 imp. gal. The level of the water in feet is indicated by a marker on the outside of the tank, and by this means it is possible to accurately gauge the capacity of the plant. The tank is supported by a steel frame resting on a concrete base, in which are located the valves and connections to the service mains and to the main drain. Steam is furnished to the compressor at 110 lbs. pressure.

Owing to the depth to which the water drops in the well three air lines are used, two being tapped into the water discharge line at different depths, and the third entering the Harris foot-piece. Each of these three air lines is controlled by a gate-valve in the power-house, and the engineer operates the system without going near the well, which is 250 ft. from the power-house. A gauge over each line shows the pressure and indicates the fall of the water in the well.

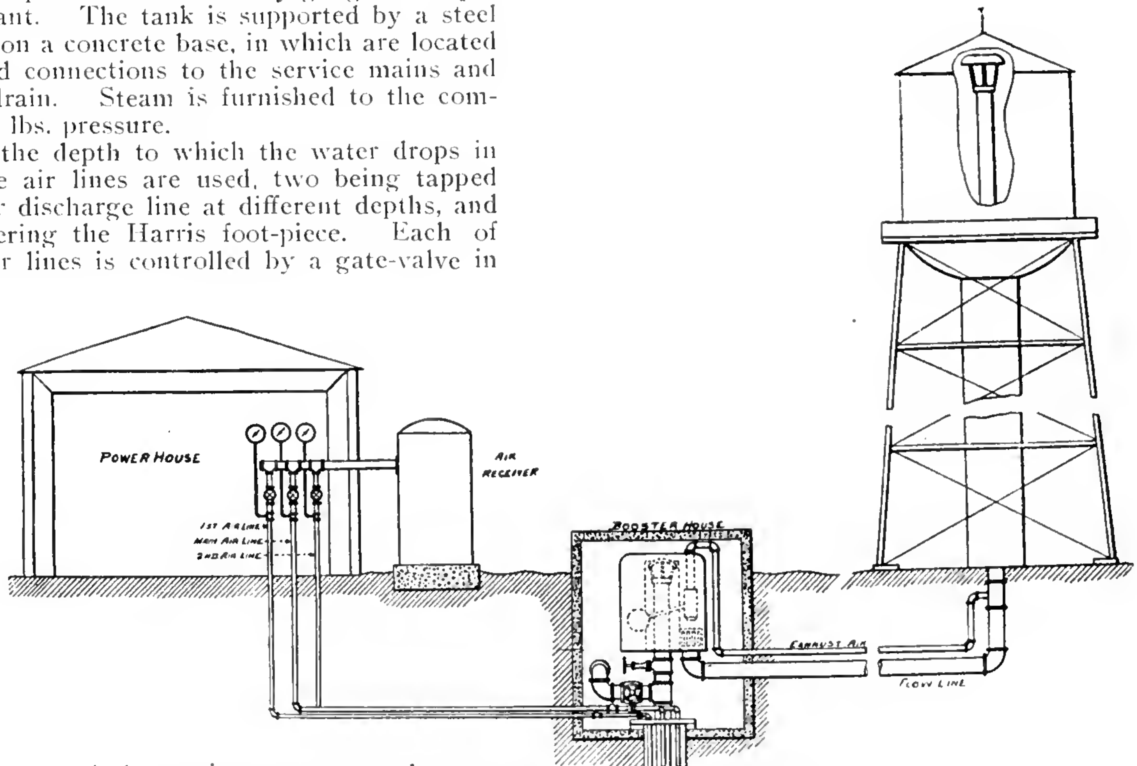
Air discharges from the compressor into a high-pressure air-receiver and from there to the well. The first air line starts the water flowing and continues to pump until the well lowers as far as this line is capable of lowering it. Then the first air line is gradually turned off until the second line begins to act. When this line has lowered the water as far as it is capable of lowering it the work is taken up by the third line and the second line is closed. The third line, which is the main pump line, then continues to furnish air as long as the system is in operation.

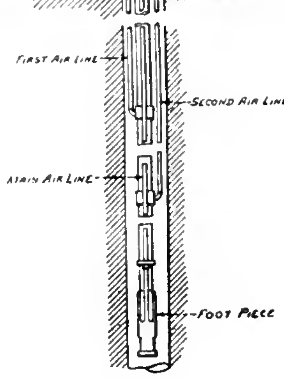
The object of the first two lines is to enable the accumulation of water in the well to be pumped away without resorting to an abnormally high air pressure. These lines are only used in starting the system.

The yield of the well is 5,400 imp. gal. per hour delivered into the tank, and under continuous operation the air pressure at the receiver is about 160 lbs. When the system is first started the yield reaches a total of about 6,000 imp. gal. per hour, this being due to the accumulation of water filling the well to the surface. The yield gradually decreases under continuous operation until the normal capacity and pumping head are reached.

At the surface the water has to be pumped horizontally a distance of 60 ft., and subsequently to a height of 90 ft. into the top of the steel tank. For this work a Harris booster operates in conjunction with the air-lift.

This booster consists of a steel tank resting on the top of the well-casing and receiving the water as it discharges from the well. The operating parts consist of a float and valve located inside the tank. The water and air are separated in this tank, the air rising to the top and maintaining sufficient pressure to force the water to the elevated tank. As the solid column of water discharges the float drops, allowing the sur-





Air-lift pump at the Quebec Bridge—pumps 5,000 gals. per hour against a head of 500 ft.

plus air to exhaust from the tank. This whole operation requires only a few seconds, as a discharge takes place every time the booster is about two-thirds full. In fact, practically a constant flow is maintained.

The surplus air may be piped back to the compressor intake or discharged into the vertical riser to lighten the column of water and reduce the operating pressure. This latter plan was followed in the case of the plant at Quebec. The booster is automatic in operation and requires no attention. It also operates without noise. This apparatus is located in a concrete sump below the ground and is reached through a door in the roof. A by-pass is connected to the main drain so that the well can be pumped directly into the sewer for cleaning purposes.

The plant was operated by the contractor for several days under the supervision of Mr. Alex. Porter, Assistant Engineer of the Transcontinental Railway, who at the completion of the test said the plant was entirely satisfactory, and the most reliable of the various railway divisional pumping units.

The high lift in this case is a noticeable feature, amounting to about 500 ft. vertical and 60 ft. horizontal. It demonstrates as far as it goes that there is practically no limit to the height to which the air lift will raise water if a fair amount of submergence is obtainable.

On a test recently the plant pumped nearly 6,000 gal. (Temp.) per hr., but this capacity was due to accumulated water near the well. The normal capacity (5,000 gal. per hr.) was developed continuously after the level dropped to 400 ft. At this point the running pressure was 160 lb. per sq. in. The highest pressure required for starting was 225 lb.

The Functions Performed by Stone in Bituminous Concrete Pavements

By R. B. Gage*

If the maximum amount of service is to be secured from any bituminous concrete pavement, it must not only be constructed by experienced men using first-class equipment, but the various ingredients composing it should be so proportioned and blended that on the one hand the benefits to be secured by the use of each will be the maximum, while on the other the injury that they may cause will be reduced to a minimum.

An examination of some of the specifications now in use describing this particular class, shows quite plainly that some of the pavements defined therein will not give as efficient service as could be secured by using the same ingredients in different proportions. These variations in grading are not the result of careful preliminary determination of the conditions to which the pavement will be subjected, with a subsequent selection of the particular grade best suited to combat these conditions. The usual object is to secure a pavement that can be constructed at a very low initial cost and yet possess all the merits of a first-class bituminous concrete pavement.

If the real value of such pavements is to be determined by the service rendered, it will be necessary to wait until their merit has been thus demonstrated before passing judgment. It is seldom that they begin to show any serious signs of failure before they are three or more years old, unless they have been laid on very inadequate foundations or were of exceedingly bad construction. During this interval a large quantity of this same grade of pavement may be laid if the firm or contractor representing the same is very aggressive. When failures begin to appear in the original pavement laid, the contractor may have gone out of business or have disappeared. Another grade is then substituted for that previously laid which may at the end of three to five years, prove to be equally as unsatisfactory as the former.

Selection of Ingredients

If errors of this kind are to be prevented, it is necessary to determine before selecting the grading just what functions are performed by the ingredients to be used. Once these have been determined it becomes possible to so proportion the ingredients that the maximum amount of benefit will be secured by their use. That this type of pavement possesses merit, when the ingredients are properly blended, has been repeatedly demonstrated and quite conclusively proven even when subjected to very adverse conditions. The numerous premature failures have also shown that if the ingredients used are not properly blended the life of these pavements will be shortened accordingly.

In the surface of a sheet asphalt pavement but three ingredients are needed, i.e., sand, filler and asphalt cement. The diameter of the largest size sand grains seldom exceeds 0.1 in. These grains have a hardness of 7 and will absorb little if any water. With a given sand the percentage of asphalt cement used is confined to fairly narrow limits. The same is also true of the filler. The life of such a surface is greatly lengthened, and its ability to resist creeping and decomposition, caused by water attack from beneath, is much reduced by laying the same on a binder course. The thickness of these surfaces varies from 1 in. to 2 ins., being generally about 1½ ins. It is not uncommon to find pavements of this type in fairly good condition after twenty years of service. Even when subjected to quite severe traffic they will last from 10 to 15 years with very little repairs, yet the original surface was not over 2 ins. thick and contained no ingredients over 0.1 in. in diameter. It is thus seen that the life or wearing properties of a bituminous pavement is not dependent upon the use of stone in the wearing surface.

Defects

If this pavement could be judged by its durability and resistance to abrasion, it would be ideal, but unfortunately it possesses certain inherent defects. It is slippery when wet and quite brittle during cold weather. On account of this brittleness a very rigid foundation is required. The grading of the aggregate calls for the use of a greater quantity and of a harder asphalt cement than is used in a bituminous concrete pavement. A greater quantity of filler is also needed. These are the most expensive ingredients used in bituminous pavements. The use of a binder course also increases the cost of construction and makes the repairing of holes more difficult than with a single course pavement.

When a certain per cent. of the aggregate of a bituminous pavement consists of broken stone larger in size than 0.1 in. in diameter, it possesses more inherent stability and density than a pavement, the aggregate of which is all smaller than 0.1 in. in diameter. The amount of inherent stability thus imparted to a pavement will vary with the size and quantity of the stone used and its thickness. On account of the added stability thus given the pavement a much softer asphalt cement can be used than in a sheet asphalt pavement and a binder couse is not necessary to prevent creeping. The percentage of voids and surface area of the

* Before the American Road Builders' Association, Pittsburgh.

aggregate can also be so reduced that about 4 per cent. less asphalt cement will be required. By using a fairly soft asphalt cement such a pavement is given sufficient elasticity and pliability during cold weather to safely allow the use of a base having a limited amount of movement. The stones contained in these pavements also prevent their surfaces from becoming as smooth and slippery as a sheet asphalt surface.

It is thus seen that the principal function of the stone are:

First, to give the pavement increased stability.

Second, to allow the use of a softer asphalt cement.

Third, to reduce the percentage of voids and surface area of the aggregate.

Fourth, to eliminate part of the slipperiness in the surface during wet and cold weather.

The first allows us to dispense with the binder course; the second admits of the use of a base that is not altogether rigid; the third reduces the quantity of asphalt below that required with a pure sand mix. All of these reduce cost.

The influence of all of these factors will naturally change with the stone content. If the maximum stability and minimum void content should be fixed between fairly definite limits. The larger sized components of the aggregate should be present in sufficient quantity to form the skeleton or framework of the pavement. The quantity required for this purpose will vary with the size, shape and grading of stone used. The greatest density is secured when the smaller sizes of the aggregate are present in sufficient quantity to just fill the voids in the larger sizes. This is best accomplished by using a fair proportion of stone whose largest dimension is about one-half the thickness of the pavement. The percentage of voids in the stone will generally be between 30 and 45 per cent., consequently the stone content of the aggregate should be from 55 to 70 per cent.

Percentage of Voids

If the fine aggregate is not present in sufficient quantity to fill the voids, the pavement is not as dense as would otherwise be the case and may not be waterproof. As the quantity of the fine aggregate is increased over that needed to fill the voids in the stone, the inherent stability is decreased and the void content in the total aggregate is correspondingly increased. If there is a considerable excess of the fine aggregate the stone simply floats in the mortar aggregate and the principal reason for its use is thus destroyed. If the use of stone did not introduce conditions injurious to the pavement, little harm would be done by its use excepting to increase the cost of the pavement. However, since a danger is thus introduced which may shorten the life of the pavement considerably, it becomes very important that the quantity of stone used should be such that the maximum benefits will be secured by its use.

The sand grains in a sheet asphalt pavement, as above stated, are practically impervious to water, have a hardness of 7 and are practically free from any definite planes of cleavage. The stone used in a bituminous concrete pavement will not meet the requirements of such a standard. Trap rock has a hardness of about 6, shows planes of cleavage and is not impervious to water. Granite, limestone and dolomite are softer yet, have more pronounced lines of cleavage and are much less impervious to water.

When in use, the thin bituminous coating is worn off the faces of the stone. The porosity of the stone is increased by being more or less shattered by the shocks of travel. When unprotected faces are thus exposed, the stones become saturated whenever the pavement surface gets wet. Moisture is thus carried into the body of the pavement and attacks the bitumen. The rapidity of decomposition of the bitumen depends first upon the porosity of the stone, and second upon the ability of the bitumen to resist hydration and oxidation. The bond between the bitumen and the stone is first destroyed and then the layers of adjacent bitumen are decomposed. When the bond between the stone and asphalt cement has been thus ruined the stones will drop out of a section of pavement when it is broken open like nuts from their shells. No trace of asphalt cement can be seen on them and their surfaces are usually bright and clean.

Quality of Stone

Certain types or grades of stone are often selected for an asphalt pavement on account of their open texture or porosity which allows the asphalt cement to penetrate into the surface of the stone to a slight extent. In this manner a better bond is supposed to be secured between the asphalt and the stone. This appears to be a step in the wrong direction, for the more porous a stone the more moisture it will absorb. A good asphalt cement will adhere to sand grains even when they are fairly smooth. No broken stone possesses any such polished surfaces. The denser, harder and tougher a stone is, the better it is adapted to fulfill the functions required of it in a bituminous concrete pavement. No trouble has ever been experienced in securing a good bond between an asphalt cement and the hardest and closest grained trap rock found in New Jersey.

In the original Topeka-Sterling specifications, if the aggregate retained on the 10-mesh sieve is designated as stone, we find that not less than 8 nor more than 32 per cent. of stone can be used. In the modified Topeka specifications recently adopted by the American Society of Municipal Improvements, the stone content may vary between 20 and 30 per cent. Each of these specifications gives a bituminous mixture in which the stones simply float in the sand aggregate. Both of these gradings give a pavement which possesses all the defects inherent in a bituminous concrete pavement and some of those peculiar to sheet asphalt, with few if any of their respective virtues. They have not the stability or density of a properly graded bituminous concrete, require a greater quantity of asphaltic cement, are more brittle and slippery, and lack the uniformity and endurance of sheet asphalt. It is claimed for these pavements that they do not infringe on certain patent rights. This certainly is not sufficient to justify their use. If their value is to be determined by the service rendered, much time and expense will be saved by selecting types of construction whose value has been definitely proven, even if the initial cost be somewhat higher. The saving in initial cost which may be made by using an improperly graded pavement is soon lost if the pavement fails prematurely. In such cases those responsible for its selection or construction are usually severely criticized and not without reason.

Exports from Canada were valued at $85,559,782 during January of this year. In January, 1915, the exports were $30,830,337, and in the same month in 1914, $29,861,359.

More Artistic Designs for Concrete Bridges

The time has arrived when we should expect our local public works to be constructed with a neater and more finished appearance, to show a degree of refinement and finish that all citizens can aspire to copy in their private undertakings. It is only too common today to see a highway bridge recently built in an extremely rough-shod and slovenly fashion.

The causes for the poor outward appearance of many of our bridges are: lack of sympathy on the part of the community for something better; failure on the

An Artistic Concrete Bridge with Simple yet Graceful Lines—A Direct Contrast to Many of our Highway Bridges.

part of the engineer to enforce specifications; lack of efficient inspection; incompetence on the part of the contractor or foreman. Some of the most prominent and flagrant defects so far as appearance are concerned are: the edges and corners not being chamfered off, they become broken and jagged; the forms are built loose and insecurely braced, and the surface of the concrete improperly spaded, the result being distorted walls, with rough, honeycombed surfaces; and the use of mortar to patch up or plaster honeycombed surfaces. These results are generally due to the use of poor materials, and poorly supported forms, which allow the concrete to settle while setting, lack of care to obtain a proper foundation, and misplacement of the steel reinforcement.

In direct contrast to these flagrant defects, the artistic possibilities of concrete are clearly set forth in the illustration, artistic in its simplicity of design. Concrete bridges can be moulded with pleasing lines at a slight increase in cost over a structure with plain, straight, ungraceful lines.

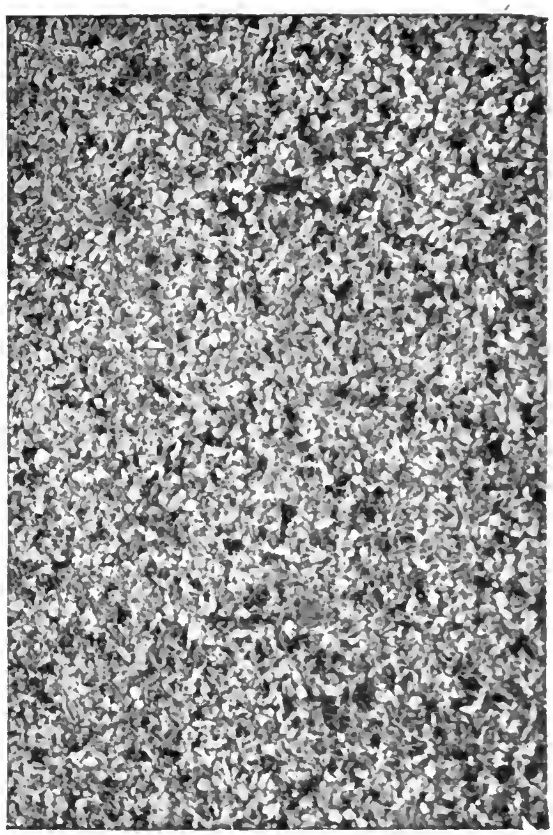
The structure shown is designed with two slightly arched girders, having a span of 54 ft. 5 ins. and a width of 14 ft. between parapets. The abutments are founded on ferro-concrete piles extending up to the under side of the girder span, where they are connected by capping, being monolithic with the decking of the bridge. The main girders are combined with the parapets, the total depth of the two being 5 ft. 7 ins., thus providing great depth and strength in the most economical manner possible. Transverse beams connect the main girders, and the structure is completed by a continuous decking slab 4 ins. thick, the whole being a monolithic connection throughout.

Water Softening by Electricity

Water softening by electricity, especially as regards boiler feed water, is attracting the close attention of American engineers. After the softening compound has been added to the water it is circulated past parallel electrodes which are placed close together in order that as much of the water as possible may be brought in contact with the surface of the plates. The ionising properties of electricity separate the compounds into their components, thereby hastening the recombination to form precipitates, which are easily removed. Ten million gallons of water per day, it is stated, may be treated with only 480 watts per million gallons.

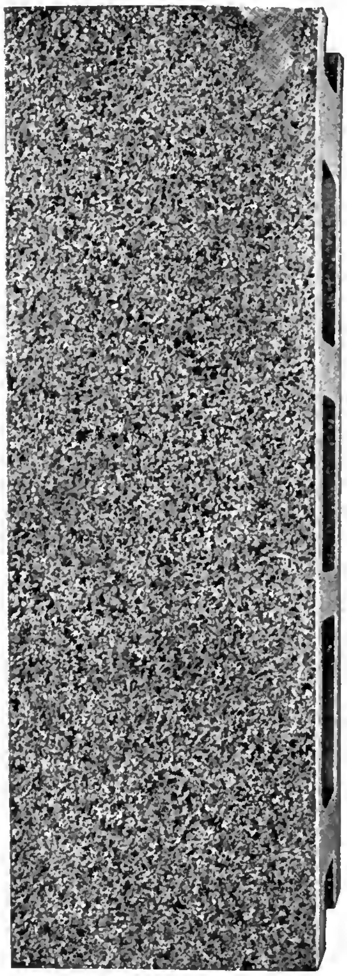
Cast Stone System of Manufacturing Cement Blocks

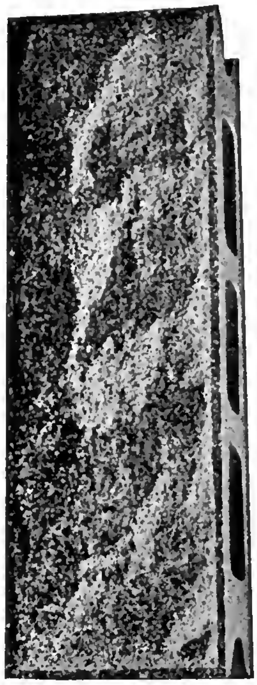
The illustrations herewith represent the products of the Cast Stone Block and Machine Company, of Windsor, Ont., who manufacture machinery for doing this work, and also operate a large cement block plant in that city. By the cast stone system you can make waterproof blocks with granite veneered facing, either rock or smooth, at less cost, it is claimed, than you can turn out an interior block by any other process. The manufacturers state that these have greater strength and durability. The appearance, as shown in the illustrations, is also very attractive. The granite-faced blocks are not an imitation product, but are cement veneered with pure granite, possessing strength and hardness equal to a solid granite block. The man-



Cast Stone Block, Veenered with Granite Crystals.

ufacturing of granite veneer is an interesting process. A face plate is first coated with thin glue, then covered with crushed granite. This company procure their granite from the quarries at Crown Point, on the Hudson River, N.Y., which is claimed to be the most beautiful and practical for this purpose of any rock or facing material known. After the glued plate is covered with granite it is turned over so that all loose particles may drop off, after which the plate is set away for a short time while the glue hardens. The moulds are then set up in the usual way, but just before they are filled the granite crystals that are now firmly held on the face plates by the hardened glue are given a coating of pure cement mixed with water to the consistency of a thin paste. This coating is applied with a brush, the purpose being to embed the crystals in a layer of pure cement. The moulds are then filled with slush concrete and the mixture left to harden. While the cement is setting the water from the wet concrete softens the glue, and the blocks when taken from the moulds are just as shown in the





Granite Rock Faced Block, Size 24 x 8 x 8 in., weight 70 lbs.

Smooth Faced Granite Block direct from mold.

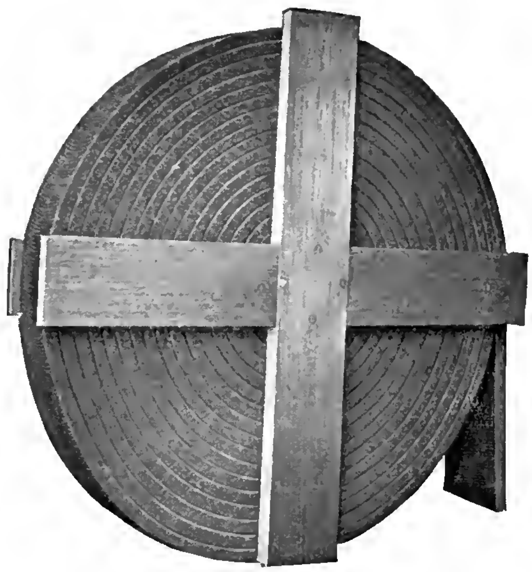
illustrations. The purpose of the glue is to hold the crystals in place and protect one side of them from cement while the block is being cast. The glue all comes away with the face plates in granular form. This method of producing building block is claimed to be a decided improvement over the dry process, in that the product is more beautiful in appearance, has greater strength, is impervious to moisture, and costs less.

Activated Sludge Defined

The best definition of the activated -sludge process of sewage treatment which he has ever seen, said T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, in a paper read before the Indiana Engineers' Society on February 3, is the one given by William R. Copeland, chief chemist for the Milwaukee Sewerage Commission, and is as follows: "The sludge embodied in sewage and consisting of suspended organic solids, including those of a colloidal nature, when agitated with air for a sufficient period, assumes a flocculent appearance very similar to small pieces of sponge. Aerobic and facultative aerobic bacteria gather in these flocculi in immense numbers—from 12,000,000 to 14,000,000 per c.c.—some having been strained from the sewage and others developed by natural growth. Among the latter are species which possess the power to decompose organic matter, especially of an albuminoid or nitrogenous nature, setting the nitrogen free; and others, absorbing this nitrogen, convert it into nitrites and nitrates. These biological processes require time, air and favorable environment, such as suitable temperature, food supply and sufficient agitation to distribute them throughout all parts of the sewage." The activated -sludge process, Mr. Hatton points out, should not be confused with the kind of artificial aeration of sewage, attempted from time to time in the past, which made no use of the sludge, as an aid to oxidation. The new process, Mr. Hatton states, "preserves the aerobic bacteria by keeping the sludge, which is their natural food, in intimate contact with air at all times and keeps them supplied with fresh food from the raw sewage, throughout the whole body of which they are in intimate contact."

A New Expansion Joint

A new material for the expansion joints of concrete, brick or block pavements is now being offered by The Barrett Company. It is a mastic which comes ready to lay, in ribbon form, in a variety of widths and thicknesses. It contains no felt or paper reinforcement. A new process known as the "Fibre Weld" process gives to the bituminous mastic the requisite cohesiveness to stand handling and storage in the ribbon form, without affecting the elasticity that is necessary for expansion requirements. It seems to



Barrett's New Fibre-Weld-Process Expansion Joint.

possess all the elasticity of a poured bituminous joint with all the advantages of easy handling. The material is waterproof and weatherproof and is not injured by street acids or automobile oils. It does not become brittle with age or cold weather and does not soften or run in hot weather. Its chief advantage over the usual poured bituminous joint is the elimination of heating or pouring apparatus and a great reduction of the labor item—as it takes only a moment to unroll the joint and cut and put it in place. It will be marketed under the name of "Barrett's Expansion Joint."

London-Port Stanley Electrification

Former Steam Road Being Successfully Operated by Electricity — Description of Main Features

After several months of operation by electricity the London & Port Stanley railway system appears to be fully justifying the hopes of the promoters of this scheme and gives promise of working out so successfully from an engineering and financial standpoint that the dream of a network of hydro radials, covering the whole of the province of Ontario, may now begin, with good reason, to take definite shape. Though, as yet, a separate unit in itself and as such, it is believed, able to show a balance of profit over operating and fixed charges, there is no doubt that this road would find its greatest usefulness as the nucleus of a larger system of radiating lines, which would act as feeders and distributers throughout considerable areas in south-western Ontario. Indeed it is the expressed policy of the engineers of the Hydro-electric Power Commission of Ontario that in seeking to standardize their equipments and system of operation they had prominently in mind the conditions that would have to be met in the years to come when Hydro radials shall be as common as Hydro transmission lines are today. For this reason practice that would naturally have been followed on a 25 mile line as a separate unit has, in many cases, been departed from, and plans substituted having in view a network of possibly ten times that amount of road in the near future.

The essential difference between the London & Port Stanley electrification and that of the earlier systems in Canada which have been considered the standard up to the present time is that the operating voltage is 1,500 d.c. instead of 600. This change of course has demanded higher factors of safety at every point and the variations in design have been worked out and undertaken largely on this account. It is of particular interest to note that the increased voltage, as such, is causing no greater operating difficulties than were experienced with the lower voltages.

Though this road is spoken of in general as an electrification of a steam line, it is, in effect, a new road from the bottom up. For many years the line has been leased to various steam railway companies and when it reverted to its owners, the city of London, in 1914, and it was decided to electrify, it was found necessary to overhaul the roadway from one end of the line to the other. To this end the old 56 pound rails were replaced by 80 pound standard steel, ties were replaced by new untreated cedar and the track was reballasted throughout. Fortunately the bridges were found, for the most part, to be in good condition but a considerable amount of concrete curbing had to be built along various parts of the line.

The Rolling Stock

Up to the present time the rolling stock acquired consists of three 60 ton electric locomotives, five 61 foot steel motor cars, three 61 foot trailers and one 61 foot express car with motor equipment. This latter car is well adapted to give a rapid delivery of farm produce into St. Thomas and London. Further equipment includes five 36 foot steam road box cars, four 36 foot steam road flat cars and three 34 foot steam road cabooses.

The specifications of the various cars are also given below in detail.

The locomotives are of the type 404 G. E. and are carried on two swivel trucks, bringing all the weight on the drivers. Equipment is housed in steel box type cab extending over practically the entire length of the locomotive. Each locomotive is provided with four G. E. 251, 750/1500 volt motors, designed for 750 volts across each armature but insulated for 1,500 volts. Two motors are connected permanently in series and the two motor groups thus formed are capable of connection in series or parallel for speed control as desired.

The cab is divided into three compartments, one at each end for accommodating the operator, with an intervening compartment to house the control equipment and accessories. 1,500 v. electric radiators are used for heating.

Each of the motors has an hourly rating of 254 h.p. with 1,500 volts on the trolley. At this rating the locomotives exert a tractive effort of 21,500 pounds. Control is by double-end Type M. standard equipment, a master controller at each operating position actuating the main 1,500 volt contactors by means of a 600 volt circuit supplied from a dynamotor. Multiple-unit train operation is arranged for so that the simultaneous control of all three locomotives coupled together can be accomplished from any master controller. The equipment is designed that the locomotive may haul a train of passenger trailer cars and provide illumination for them.

Current is collected by pantograph slider trolleys having two contact pans pressing against the trolley conductor. Both ends of the locomotives are provided with pantographs. The pantographs are electro-pneumatically controlled from any operating position with 1, 2 or 3 locomotives hauling a train. The pantograph equipments on the motor-cars and express car are identical with those on the locomotives.

Express Car

Body—Length of body, 59 ft. 6 in.; length over-all, 61 ft.; width over-all, 9 ft. 2¾ in.; height from top of rail to top of trolley board, 13 ft.; truck base, 40 ft.

Truck—Type, National Steel Car Co.; wheel base, 7 ft.; diam. of wheel, 36 in.; tread of wheel, 4 11-32 in.; type of wheel, steel tread; size of journal, 5 in. by 9 in.; diam. of axle, 6 in.

Fig. 1.—Standard steel pole carrying trolley, feed and signal system wires.

Electrical equipment—Motors, type G. E., 225 B. 750 1,500 V.; motors, 4-125 h.p.; control system, Sprague, type M.; controller, hand control; gear, number of teeth, 57; pinion, solid teeth, 21; type of air compressor, G. E., C. P., 27-A.; size of air compressor, 35 ft.; size of brake cylinder, 14 in.; type of governor, M. L., Form A., G. E. Co.; type of car heater, 1,500 volt Consolidated Car Heater Co.; type of pantograph, G. E. slider trolley; type of pilot, steam locomotive type; type of snow scraper, H. E. P. Comm.; type of headlight, U. S. Incandescent; type of hand-brake, Peacock.

General—Weight of body, 32,000 lbs.; weight of trucks

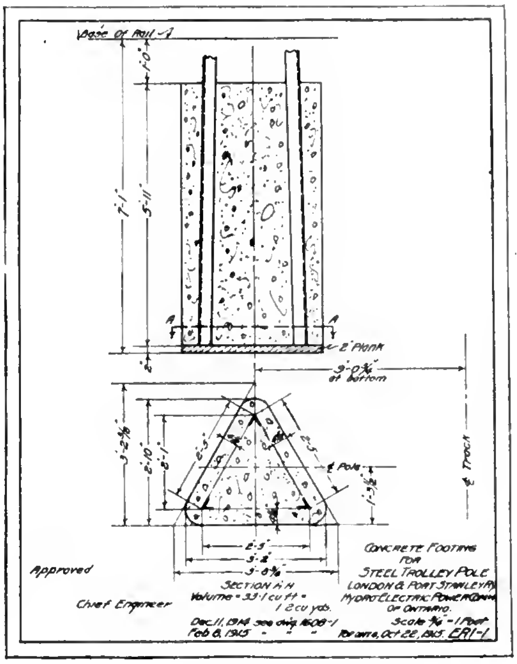


Fig. 2.—Standard steel pole footing

with wheels and axles only, 21,800 lbs.; weight of electric and air-brake equipment, 28,000 lbs.; total weight of car complete, 81,800 lbs.

Motor Cars

Body—Length of body, 59 ft. 6 in.; length over-all, 61 ft.; width over-all, 9 ft. 6 in.; height from top of rail to top of trolley board, 13 ft. 5¼ in.; seating capacity, 56; truck base, 34 ft. 4 in.

Truck—Type, Baldwin Locomotive Co., M. C. B.; wheel base, 7 ft.; diameter of wheel, 36 in.; tread of wheel, 4 11-32 in.; type of wheel, steel tread, M. C. B.; size of journal, 5 in. by 9 in.; diam. of axle, 6 in.

Electrical equipment—Motors, type G. E. 225 B, 750/1,500 V.; motors, 4-125 h.p.; Control system, Sprague, Type M.; controller, hand control; gear, number of teeth, 57; pinion, solid teeth, 21; type of air compressor, G. E., C. P., 27 A; size of air compressor, 35 ft.; size of brake cylinder, 14 in.; type of governor, M. L., Form A., G. E. Co.; type of car heater, 1,500 volt Consolidated Car Heater Co.; type of pantograph, G. E. slider trolley; type of car seats, Heywood Bro. & Wakefield Co.; type of pilot, steam locomotive; type of snow scraper, H. E. P. Comm. design; type of headlight, U. S. Incandescent; type of hand brake, Peacock.

General—Weight of body, 40,000 lbs.; weight of trucks with wheels and axles only, 24,000 lbs.; weight of electric and air brake equipment, 28,000 lbs.; total weight of car complete, 94,800 lbs.

Trailer Cars

Body—Length of body, 59 ft. 6 in.; length over-all, 61 ft.; width over-all, 9 ft. 6 in.; height from top of rail to top of trolley board, 13 ft. 5¼ in.; seating capacity, 60; truck base, 34 ft. 6 in.

Truck—Type, National Steel Car Company; wheel base, 6 ft.; diam. of wheel, 34 in.; tread of wheel, 4 11-32 in.; type of wheel, cast iron; size of journal, 5 in. by 9 in.; diam. of axle, 5⅜in.

Equipment—Control system, Sprague, type M; controller, hand control; size of brake cylinder, 14 in.; type of car seats, Preston Car & Coach Co.; type of pilot, steam locomotive; type of snow scraper, H. E. P. Comm. design; type of headlight, U. S. Incandescent; type of hand brake, Peacock.

General—Weight of body, 40,000 lbs.; weight of trucks with wheels and axles only, 20,000 lbs.; weight of electric and air-brake equipment, 2,661 lbs.; total weight of car complete, 62,661 lbs.

Locomotives

Body—Length of body, 28 ft.; length over-all, 37 ft. 4 in.; width over-all, 9 ft. 7¼ in.; height from top of rail to top of trolley board, 12 ft. 10⅛ in.; truck base, 17 ft. 6 in.

Truck—Type, G. E., M. C. B.; wheel base, 7 ft. 2 in.; diam. of wheel, 36 in.; tread of wheel, 4 11-32 in.; type of wheel, solid steel; size of journal, 5½ x 10; diam. of axle, 7 in.

Electrical equipment—Motors, type G. E. 251 R 750/1500 V.; motors h.p. 250; control system, Type M, multiple unit; controller, type C. 107 A; gear, number of teeth, 70; pinion, solid teeth, 16; type of air compressor, 2-C. P. 30; size of air compressor, 35 C. F. per M.; size of brake cylinder, 16x12; type of governor, G. K. 3; type of car heater, 1,500 v. Consolidated Car Heater Co.; type of pantograph, slider trolley; type of pilot, G. E. design; type of

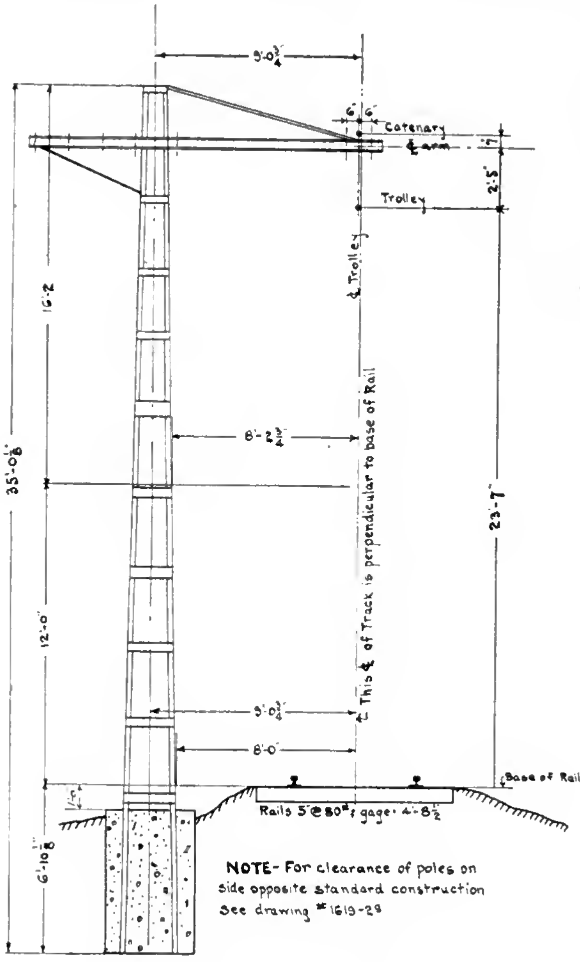


Fig. 3.—Standard steel pole.

headlight, U. S. Incandescent; type of hand brake, rachet and drop lever type.

General—Weight of electrical equipment, 38,950 lbs.; total weight of car complete, 120,000 lbs.

Car Construction

The passenger car is built of steel, with wood trim; the entire bottom is structural steel, diagonally braced; the end and vestibule framing has special provision against the destructive effects of collision; corner posts and side posts are of channel construction; side sheathing and roof, steel plate; inside trim of car is solid mahogany inlaid in quarter-cut finish; the vestibule is finished in steel with ash trim with the exception of the doors and windows, which are mahogany. Each vestibule has two drop windows, a 26-in. end door, and two 29-in. side swinging doors.

The interior finish is green, with plush seats of high-back design in the main compartment, and pantasote imitation leather, high-backed seats for the smoking compartment. Solid bronze metal trimmings are used in the main compartments. The toilet rooms are of white sheet steel with white enamel and white steel fittings. The exterior finish of the car is black.

At each end of the car is placed a steam locomotive type iron pilot, on the top of which is a steel plate snow plow controlled by levers from the operating platform.

Lighting and Heating Circuits for Cars

The voltage for the lighting and heating circuits is cut down from 1,500 to 600 volts d. c. by means of a dynamotor. The lighting arrangement consists of five three-cluster semi-indirect ceiling fixtures in the main compartment, one light in each cluster being in series with the corresponding light in the next cluster; also there is a sixth three-cluster semi-indirect ceiling light near the toilet room with its three lights in series with the two lights in the toilet rooms. The baggage room and vestibule lighting consists of two series circuits of five lights each, these circuits being controlled by two three-way switches, one in the baggage room, the other in the vestibule. All lights are controlled from a switchboard in the baggage room. All circuits are 600 volts d.c., grounded, with five lights in series.

Fig. 4.—Special design trolley wire hanger.

The car is heated by means of thirty-six electric heaters, placed on the walls, two in the vestibule, one in each toilet, twenty-eight in the main compartments, and four in the baggage room. The heaters are connected in two circuits of 18 each in series, and are supplied from the switchboard in the baggage room.

Lighting Arrangement in Passenger Cars

One of the figures shows the complete wiring diagram of the passenger cars. The lighting arrangement consists of six three-lamp semi-indirect ceiling clusters in the main compartments, five lights in the baggage room, four lights in the toilet rooms, and three lights in the vestibule. The lighting arrangement is to operate five 120-volt lamps in series on the 600-volt service. To obtain this number one lamp in each of the first five main clusters is connected in series with the corresponding lamp in the next cluster. This makes three complete circuits, but if any one of the circuits becomes dead only one lamp in each cluster goes out. The three lamps in the sixth cluster are all in series, together with two lights in the toilets. For the vestibule and baggage room lights a unique scheme has been worked out whereby the motorman may light the vestibule or the baggage room at his convenience for the accommodation of passengers entering or leaving the car. By means of two three-way switches, one in the vestibule and the other in the baggage room, the motorman can, from whichever end he happens to be operating from, turn out the lights in that end without interfering with the lights at the other end, and can, during stops, illuminate both ends.

Control System

The system of control is the non-automatic type M, two-speed multiple unit, arranged to operate the motors in series and series parallel. The two pairs of motors, with their resistances, are all in series on the first point of the controller, the resistances being varied through the first nine points on the controller and short-circuited on the tenth or running point. An electro-pneumatic operated change-over switch is used to make the transition between series and series parallel. Either pair of motors may be cut out by means of a separate handle on this switch. The control system is so arranged that at least six motor cars can be operated as a unit from either end of any car.

The Pantograph

The current collectors are the sliding pantograph type of trolley, two pantographs per motor car. These pantographs are pneumatically raised and automatically lower themselves when the pressure is released. Each pantograph can be raised or lowered from any operating position in either the motor or trailer car. Each is provided with a cut-out plug to render it inoperative without interfering with the other pantographs. The design of the pantograph is practically standard, with the exception that the legs extend downward through the common hinge. This construction permits of a greater vertical range.

The Source of Supply

The supply of electric energy is taken from the lines of the Hydro-electric Power Commission of Ontario at London and St. Thomas. At these two points arrangements were made for housing the converting equipment in sub-stations already built, so that no new sub-stations were required for the railway system. In London the equipment was installed in one of the sub-stations of the local hydro commission and in St. Thomas space was available in the high tension station of the Ontario Commission. In each of these two stations two 500 kw. rotary converters 13,200 a.c. to 1,500 d c. were installed. Feed wires are 500,000 c.m. aluminium.

The Overhead Line

The overhead work is carried on triangular steel poles which are utilized for the combined purpose of supporting the feed wires, the trolley wire and the wires of the dispatching system. A pole drawing with cross-arm and showing relative location of the various circuits is shown herewith. Specifications of poles are as follows:—Weight, 800 lbs.; material, galvanized structural steel angles; height, 35 feet; base, concrete, 7 feet in depth, one foot exposed above surface, Fig. 2, cross arms, 4 in. channel; height of cross-arm, 26 ft. above rail; distance apart of poles, 140 to 180 ft.; strain test at top of poles, 2,500 lbs. In yards wooden poles are used with span wires, the standard spacing being 90 feet.

Anchoring and Sectionalization

The details of the overhead are shown for the most part in the accompanying line drawings and photographs. The line is anchored every three-quarters of a mile by steel poles One of these is placed on the other side of the track opposite a standard pole and connected by anchored wire to the next adjoining standard pole.

The trolley and the supply system are sectionalized about every four miles; the sectionalization arrangement is as indicated in one of the illustrations herewith.

Contact System and Type of Suspension

On all main line work catenary suspension is used. The catenary wire is 300,000 c.m. copper, and the trolley is 4/0 grooved. A special design for the trolley wire suspension was developed by the Commission for this contract. A clip with a lip, see figure, fits into a groove on each side of the trolley wire, and is clamped into place and suspended by a hanger to the catenary. These suspension clips are placed every 20 ft. on the main line. In yards, where the poles are most closely spaced, direct suspension is employed as shown.

Rail Bonding

Bonds are of 4/0 copper, welded to the outer side of the rail heads. The oxy-acetylene process was used. In practice, the bonds together with a tank each of oxygen and acetylene gas were carried on a light hand car, the whole outfit being operated by one man. Both rails are bonded.

Operating records of such equipment and apparatus are

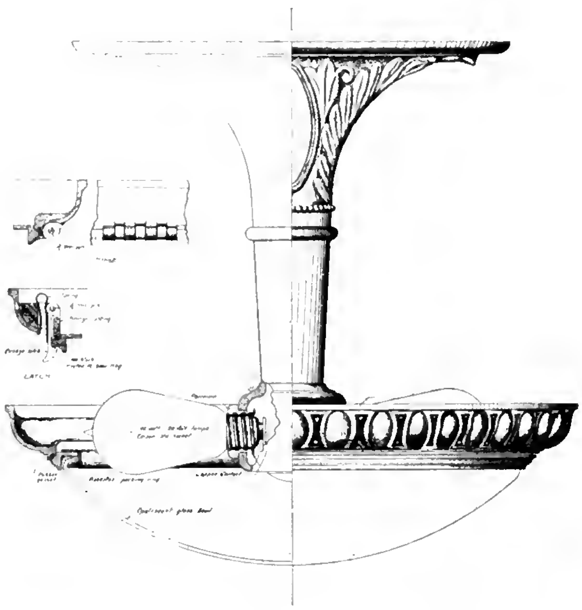


Fig. 5. Type of semi-indirect unit used on passenger cars.

interesting, and it might be pointed out that during the last five months since this road was placed in operation, interruptions to service have been negligible.

New Books

Irrigation Practice and Engineering—by B. A. Etcheverry, head of the Department of Irrigation, University of California. McGraw-Hill Book Company, Inc., New York, publishers; price $4 net. This is Volume III. of a series of text-books, of which the two latter volumes are devoted to a presentation of the fundamental principles and problems of irrigation engineering. The present volume is devoted particularly to irrigation structures and distribution systems. Illustrated by twenty plates and 186 figures; 438 pages; bound in the usual type of this publishing house; approximately 9 by 6 inches.

The Western Canada Lime Company, Limited, has been incorporated with a capital of $100,000 and head office at New Westminster, B.C.

Personal

Mr. Jules Alexander Duchastel, B.A.Sc., the new president of the Canadian and International Roads Congress, is engineer for the city of Outremont, P.Q. He took a leading part in the recent congress, reading a paper, and speaking on several subjects. Mr. Duchastel, who comes from an old French family, graduated in 1901 at Laval University. For a short time he was with the Phoenix Bridge and Iron Works, and then for five years was on the engineering staff of the C. P. R., construction of bridges and elevators de-

Mr. J. Duchastel, Mem. Can. Soc. C. E.

partment. In 1907 he was appointed engineer for the town of Outremont, then a comparatively small suburb of Montreal. Under Mr. Duchastel's supervision extensive works have been laid out, including a new sewage system, a lighting system and road programme. Last year Outremont obtained a city charter; it is one of the finest outlying districts of Montreal, with a beautiful park, wide streets, and splendid residences.

Mr. K. H. Smith, of the Nova Scotia Water Power Commission, delivered an address on "Some engineering features of the Pan-Pacific International Exposition, with particular reference to the lighting arrangements and the Canadian exhibit," before the Nova Scotia Society of Engineers at their regular monthly meeting held at the Technical College, Halifax, on March 15. The lecture was illustrated by a large number of slides specially prepared for the purpose.

Mr. Hugh Watkins, of London, England, who is the quantity surveyor for the Manitoba Parliament Buildings, and in this capacity is required in Winnipeg to arrange and prepare the quantities for the tenderers, tried recently to leave for Canada, but was forbidden to do so by the military authorities, being eligible for military service. The Hon. T. H. Johnson, however, wrote to Acting High Commissioner Perley in London, asking him to assist Mr. Watkins in getting away, and has now received word that the matter has been satisfactorily arranged. Mr. Watkins will bring with him designs for a dome drawn by S. Bylander, an English engineer.

Obituary

Mr. W. L. McGiverin, vice-president of Dartnell, Limited, builders supplies, Montreal, died suddently on March 17, at his residence, Regent Avenue, Montreal, aged 40. He was operated on a short time prior to his death for varicose veins; the operation was apparently successful, but he became suddenly ill, and died within a day or two of taking to his bed. Mr. McGiverin, who served in the Boer war, was a native of Toronto.

Mr. C. H. Conery, who carried on a cement and contracting business in Guelph for many years, died on March 10.

Mr. Charles Sellers, head of the Peerless Furniture Company, Toronto, died suddenly on March 20, at the age of 83. Mr. Sellers was born in Glasgow, Scotland, and came to Canada when about eighteen years of age.

Mainly Constructional

East and West—From Coast to Coast

Machineries, Limited, Montreal, have been incorporated.

Rochefort & Normand, plasterers, Montreal, Que., have registered.

The Deakin Construction Company, Quebec, Que., have registered.

V. Marcotte & Cie, bricklayers, Montreal, Que., have registered.

Dussault & Verrall, contractors, Montreal, Que., have registered.

Theodule Lessard & Fils, general contractors, Montreal, Que., have registered.

The Renfrew Machinery Company, Limited, Renfrew, Ont., were burned out recently; loss insured.

There are indications of considerable building activity in Amherst, N. S., during the spring and summer.

The Ottawa Board of Control at a recent meeting decided to advertise for a Commissioner of Works.

It is reported that the Bell Telephone Company will erect a new exchange building in Barrie this summer.

The Dominion Salvage & Wrecking Company, Limited, has been organized, with head office in Toronto and a capital of $25,000.

Canadian Welding Works, Limited, is the name of a newly-incorporated concern with head office at Montreal and a capital stock of $10,000.

Ice conditions at Port Arthur seem favorable to an early opening of navigation. Grain in the elevators at the head of the lakes totals approximately 35,000,000 bushels.

The Dominion Bridge Company have been awarded the contract for the steel work for the T. Eaton Company new building at Winnipeg. The cost of the steel alone is estimated at $200,000. The building will be 200 feet long by 123 feet deep and eight storeys high.

The first steps are now being taken towards rebuilding the Northern Navigation wharf at Sarnia, Ont. A steam pile driver will start at once to drive the piles which will support the structure. Owing to the great depth of water at this point, long piles are required for the work.

Leading dealers in building supplies in Saskatoon, Sask., report having been called on for more estimates in the last three months than in all the year of 1915. The demand is very considerable from the farming communities, where many good buildings will be erected this season.

Montreal will have to pay a considerably higher price for its asphalt this year. The tender of the Warner-Quinlan Asphalt Company for 6,000 tons at $19.33 per ton has been accepted by the Board of Control. This is nearly $5 per ton above that of last year, when the contract was the subject of much legislation. The bids ranged from $19.33 to $32.40 per ton.

Under the patronage of Their Royal Highnesses the Duke and Duchess of Connaught, the Ottawa Chapter of Architects, during the week beginning March 27th, will hold an exhibition of architectural drawings, paintings, sculpture, etc. Messrs. Darwin's, Limited, have placed at the disposal of the Association the shop at No. 43 Sparks Street, in the Union Bank Building. The proceeds will be devoted to patriotic purposes.

That German prisoners of war confined to Fort Henry were employed by a Kingston contractor at the rate of 75 cents a day to do work inside the walls of the fort was a matter which came up for discussion at a meeting of the Trades and Labor Council of Kingston, Ont. The contractor claimed that the men were employed because no other labor was available. The Trades Council declared that there were sufficient local men available. The members of the Council have been given assurance that these prisoners will not be employed again.

The Conley Frog and Switch Company, of Memphis, Tenn., have agreed to have complete and in operation by July 31 the plant which they started between Port Arthur and Fort William in 1913, and which they were unable to carry on because of the financial conditions created by the war. They will manufacture frogs, switches, bolts, nuts, and all railway accessories, and will employ at least fifty men. They have agreed to expend $100,000 on the works, and the city of Port Arthur is to allow them a bonus of $25,000 when the plant has been in operation for thirty days.

The full pamphlet copy of the annual report of the Bethlehem Steel Corporation for 1915—the first full year of the war—is just being issued. A summary of the chief feature of the report, made public recently, shows the total net earnings, from operations of the corporation and its subsidiary companies, after deducting expenditures for ordinary and extraordinary repairs and maintenance—"approximately $4,391,000"—amounted to $24,821,408.25, compared with $9,649,667.71 in 1914. The orders on hand on December 31, 1915, amounted to $175,432,895, against $46,513,189 on the corresponding date in 1914.

The Roman Catholic School Commissioners of Montreal, having awarded a contract to Mr. Joseph Laurier for the construction of a school at a price of $176,700, Mr. F. A. Grothe asked Mr. Justice Dugas, in the Practice Court, for an interlocutory injunction, to prevent the execution of the contract. The contention was that Mr. Grothe, being the lowest bidder, ought to have secured the contract, and that there was nothing in the plea of the Commissioners that Mr. Grothe was not a resident of the city. The Commissioners, it was stated, had given the contract to the successful bidder on condition that he executed the work at the price asked by the petitioner. The judge dismissed the petition on the ground that the Commissioners were not bound to accept the lowest tender.

The Ontario Government, in making good its pledge to develop actively the resources in Northern Ontario, has spent in the last three years close on three million dollars. Up to the end of the provincial year of 1914 the province had expended $2,076,833, while last year the expenditure totalled $689,910, of which $582,914 was spent on road construction. Commissioner Whitson reports that 597 miles of new road were cut out of the virgin forest during the year, 281 miles of new and old roads were graded and surfaced with gravel or stone, and 113 miles of old roads were partly graded or improved. In all 872 miles of road were under construction. In addition to this a dam was built 450 feet in length, across the Frederickhouse River to improve navigation on Night Hawk Lake and tributary streams.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Berlin, Ont.
The City Council will receive tenders until April 13th for the construction of about 6,000 square yards of concrete pavement. Engineer, H. Johnston.

Chatham, Ont.
Work will start as soon as weather permits on the construction of reinforced concrete pavement on King Street East and Lansdowne Avenue. Approximate total cost, $13,360. Engineer, F. P. Adams.

Collingwood, Ont.
Tenders will be received until 8 p.m., April 11th, for the following:—(1) pumping machinery, consisting of two motor-driven units, with a capacity of 1,000 Imperial gallons each; (2) pump well and connections. Engineers, Chipman & Power, Mail Building, Toronto.

East Farnham, Que.
The Secretary to the Village Council, M. Stevens, will receive tenders until noon, April 15th, for the gravelling of the main road through the Municipality.

Halifax, N.S.
The Mayor, P. F. Martin, will receive tenders until April 5th for the supply of 5,000 feet of cast iron pipe. Specifications with City Engineer.

Lethbridge, Alta.
The City Council are considering the installation of a filtration plant. Engineer, A. M. Grace.

London, Ont.
Tenders are now being received for the construction of about 60,000 square yards of asphalt pavement. Engineer, H. A. Brazier.

Moncton, N.B.
The City Engineer, J. Edington, has been instructed to prepare specifications and to obtain estimates on the following kinds of pavement:—creosoted pine block on concrete foundation; bitulithic on concrete; asphalt on concrete.

Quebec, Que.
Tenders will be received until April 4th by the Waterworks Engineer for the following supplies:—pig lead, lead pipe, cast iron pipe, iron and brass castings, cement, brick, drain pipe.

Toronto, Ont.
A by-law has been passed authorizing the construction of a foot subway under the Grand Trunk Railway at Ashdale Avenue. Commissioner of Works, R. C. Harris.

The Board of Control will receive tenders until April 11th for electrically operated driving gear for a 36-inch gate valve at the Main Pumping Station. Plans at Room 12, City Hall.

Commissioner of Works, R. C. Harris, has recommended the following works:—cement sidewalks, $1,587; rocmac macadam pavements, $22,835; asphalt pavements, $5,320.

CONTRACTS AWARDED

Wallaceburg, Ont.
The Town Council have let the contract for the supply of water service equipment to Mueller Bros. Company, Sarnia.

Railroads, Bridges and Wharves

Alberta Province
A delegation has urged the Government to complete the projected portion of the Canadian Northern Railway between Medicine Hat and Hanna.

CONTRACTS AWARDED

Edmonton, Alta.
The Edmonton, Dunvegan & British Columbia Railway have awarded contracts to McPherson & Quigly, 119 Adams Block, for the construction of a bridge over Burnt River and for the piers and abutments for the bridge to be built over Smokey River.

Public Buildings, Churches and Schools

Brampton, Ont.
The Town Council have passed a grant of $18,000 to the School Board for the erection of a four-roomed school. Secretary to the Board, John D. Gordon.

Dalroy, Alta.
Tenders on the construction of a frame school for School District No. 2690 will be received until noon, April 5th, by the Secretary, F. W. Gardner.

Harcourt Township, Ont.
The Trustees of School Section No. 1 will call for tenders about May 1st for the erection of a school. Estimated cost, $9,000.

Hespeler, Ont.
The Roman Catholic Congregation propose to build a new church as soon as possible, at an approximate cost of $10,000. Priest, Rev. Father Meyer.

Mimico, Ont.
Victoria Industrial School Board have approved plans for a school, estimated to cost $4,000. Work will be done by day labor and material purchased by Superintendent C. Ferrier. Steel and brick construction.

Montreal, Que.
The Protestant Board of School Commissioners, Belmont Street, are receiving tenders on the erection of a brick school on De Jumonville Street. Closing date, April 3rd.

North Vancouver, B.C.
The School Board propose to build an addition at the North Lonsdale School, estimated to cost $3,500.

Parry Sound, Ont.
The Board of Education have appointed Angus & Angus, of North Bay, as Architects for the proposed school.

Raleigh & Tilbury, Ont.
Charles Tompkins, Merlin P. O., will receive tenders until April 8th for the erection of a school for Union School Section No. 2. Architects, Adams & Adams, Market Chambers, Chatham. Approximate cost, $4,000.

St. Julienne, Que.
Tenders on interior work and the installation of furniture and fixtures at the Parish Church are being received by the Architect, J. O. Turgeon, 55 St. Francois Xavier Street, Montreal.

Tavistock, Ont.
The School Trustees propose to build an addition to the school, at an approximate cost of $5,000. Architect, J. S. Russell, 21 Downie Street, Stratford.

York County, Ont.
The ratepayers of School Section No. 14 are considering the erection of a school, at an approximate cost of $6,000. Secretary, F. J. Mulholland, Eglinton R. R.

CONTRACTS AWARDED

Cayuga, Ont.
The general contract for the erection of an addition to the school has been let to William Rolston. Brick construction. Approximate cost, $7,000.

Fort William, Ont.
The contract for installation of heating and plumbing at St. Luke's Church has been let to Anderson & Company, Donald Street.

Hamilton, Ont.
The Board of Education have awarded the following contracts for the erection of an addition to the Robert Land School:—masonry, G. F. Webb, Wentworth Street, $13,829; carpentry, John Poag, 685 Main Street E., $6,469; steel, Hamilton Bridge Works, Bay Street N., $4,750; roofing, M. V. McLean, 314 Hess Street; plastering, Hill Bros., 307 Emerald Street; painting, William Dodson, 121 Victoria Avenue N.; plumbing, Adam Clark, 7 Main Street W., electrical work, Electric Supply Company, 65 James Street South.

Montreal, Que.
The Cote des Nieges Roman Catholic School Commissioners have let the following contracts for the erection of a school and residence:—general, masonry, wrought iron, carpentry, plastering, painting and glazing, E. N. & U. Boileau, 312 Fabre Street; steel, Phoenix Bridge

& Iron Works, Limited, 83 Colborne Street; roofing, plumbing and electrical work, Thomas O'Connell, 183 Ottawa Street; steam heating and ventilating, T. Lessard & Sons, Limited, 191 Craig Street East.

Ottawa, Ont.
In connection with alterations to the County Jail, the contract for electrical work has been let to Stanley Lewis, Richmond Street, Westboro.

Rimouski, Que.
The contract for interior work at the Chapel has been awarded to A. M. Morin, Trois Pistoles. Architect, P. Levesque, 115 St. John Street, Quebec. Approximate cost, $5,000.

St. Julienne, Que.
The contract for plumbing at the Parish Church has been awarded to Hickey & Aubut, 93 Dominion Street, Montreal.

Woodhouse, Ont.
The general contract for the erection of a school for the Trustees of School Section No. 12 has been awarded to William Rankin, Port Dover. Approximate cost, $5,000. White brick construction.

Business Buildings and Industrial Plants

Bathurst, N.B.
All work required in the erection of a store for W. J. Kent & Company, Limited, will be done by day labor. Approximate cost, $8,000.

Berlin, Ont.
Plans are being prepared by W. C. Cowan, 200 Victoria Street, for a factory to be built for the Canadian Regal Motor Company, Limited, 433 King Street E. Tenders will be called shortly. Estimated cost, $18,000.

Brampton, Ont.
The Acme Rubber Company propose to build a factory, at an approximate cost of $30,000, and a by-law will be submitted to authorize certain concessions to the Company. F. D. Law, 471 Yonge Street, Toronto, is interested in the project.

Brantford, Ont.
The Waddell Preserving Company are considering the erection of a factory. President, F. W. Ryerson, 167 West St.

Bromptonville, Que.
The Model Dress Company intend to rebuild their premises, which have been destroyed by fire.

Clarkson, Ont.
Sproatt & Rolph, 36 North Street, Toronto, are preparing plans of a barn for W. G. Gooderham, 42 Elm Street, Toronto.

East Branch, Ont.
George McCreary proposes to build a barn in the spring. Frame construction. Estimated cost, $3,000.

Grand Prairie, Alta.
C. B. Foster is considering the erection of an elevator, with a capacity of 20,000 bushels.

Hamilton, Ont.
Work will be started as soon as possible on the construction of a coke oven plant for the Hamilton By-Products Coke Ovens, Limited, Sun Life Building. Estimated cost, $2,000,000. Plans will consist of 60 ovens and buildings for the manufacture of by-products.

Listowel, Ont.
Hydro Electric Radiation, Limited, are considering the erection of a factory. Manager, G. E. Harrison, 701 Traders Bank Building, Toronto.

Marieville, Que.
The erection of a store is contemplated by J. P. Leduc. Estimated cost, $5,000.

Markham, Ont.
The Markham Agricultural Society propose to erect two buildings at an approximate cost of $12,000. Secretary, A. W. Milne.

Moncton, N.B.
Plans are being prepared by W. C. Barns, Wyse Building, for stores and offices to be built for G. V. Steeves, 164 Park Street. Estimated cost, $15,000.

Nelson, B.C.
The British Columbia Telephone Company, Vancouver, are considering the erection of an exchange building.

Niagara Falls, Ont.
The Perfection Tire & Motor Company of Canada, Limited, Fort Madison, Iowa, will have plans prepared for a factory. A site has been selected.

G. Hutton, Bank of Hamilton Building, Hamilton, is preparing plans of an addition to the premises of the Bank of Hamilton, Queen Street and Erie Avenue. Work will start shortly.

North Vancouver, B.C.
L. E. Ross, care of Capilano Cedar Company, North Vancouver, is considering the erection of a shingle mill.

Ottawa, Ont.
Jackson Booth, Booth Street, proposes to build a five-storey addition to an office building. Steel and brick construction.

Tenders will be called shortly for the erection of an addition to an office building for Blackburn Bros., Union Bank Building. Architect, W. E. Noffke, Plaza Building, Rideau Street. Estimated cost, $18,000.

Jackson Booth, Booth Street, proposes to build a two-storey addition to an office building on Rideau Street. Steel and brick construction.

Outremont, Que.
Tenders will be received until April 6th for the erection of a garage for Wilfrid Duquette, 339 St. Joseph Boulevard West. Architect, S. Frappier, 2238 Park Avenue. Reinforced concrete and brick construction.

Perth, Ont.
Plans are being prepared for a garage to be built on North Street for James & Reid, Gore Street. Estimated cost, $5,000.

Port Arthur, Ont.
Work will start in the spring on the construction of an elevator for the Saskatchewan Co-operative Elevator Company, Limited, 12th and Smith Streets, Regina.

Quebec, Que.
The Quebec Harbour Commissioners, Pointe-a-Carey Wharf, will receive tenders until April 15th for the erection of a freight shed and grain galleries. Chief Engineer, St. George Boswell.

A site on St. John Street has been acquired by a Syndicate for the erection of a summer garden theatre. S. H. Kippan, 75 St. Louis Street, is an interested party.

Renfrew, Ont.
O'Briens Munitions, Limited, propose to rebuild their factory, at an approximate cost of $75,000. Plans will be prepared by the Company's Architect.

Sault Ste. Marie, Ont.
The Algoma Steel Corporation have made arrangements for the erection of a large addition to their plant. Estimated cost, $50,000. Steel will be supplied by owners.

Spirit River, Alta.
F. Brown has commenced the erection of a store.

The Union Bank are about to start work on the erection of a bank on Centre Street.

Squamish, B.C.
H. Butterfield, Squamish, will start work in the spring on the construction of a shingle mill on the Pillchuck River. Estimated cost, $10,000. Dry kiln equipment will be purchased.

St. Catharines, Ont.
T. H. Wiley, 128 St. Paul Street, is receiving tenders on various trades required in the erection of a factory for the Dominion Food Company, Russell Avenue. Approximate cost, $20,000.

Toronto, Ont.
The Board of Control will receive tenders until March 28th for the erection of a fire hall on Hendrick Street, estimated to cost $24,000. Plans at office of the City Architect.

Plans have been prepared for an addition to the candy factory of Robertson Bros., 103 Queen Street East, estimated to cost $25,000. Steel and brick construction. Superintendent of Construction, William Robertson.

G. C. Briggs, 34 Victoria Street, is preparing plans for alterations to a warehouse at 46 Front Street East for the Canadian Northern Railway Company, 1 Toronto Street.

Tenders are now being received for the erection of stores and apartments at 1307 Dufferin Street for A. E. Cornelius, 50 Walker Avenue. Brick construction.

Tenders are being received for the erection of a garage at Yonge and Baxter Streets for W. J. Fennell, 6 De Lisle Avenue. Estimated cost, $10,000. Concrete and brick construction.

Tenders are now being received for the erection of four stores and apartments for J. R. Gibson, Bank of Commerce Building, St. Clair Avenue and Dufferin Street. Estimated cost, $30,000. Architect, J. G. Ure, Bank of Commerce Building.

The Board of Control will receive tenders until April 11th for the erection of a barn at the Jail Farm, estimated to cost $25,000. Revised plans at office of the City Architect.

Tenders will be received until April 11th by the Board of Control for the erection of a stable and wagon house at the Island. Plans at office of the City Architect. Estimated cost, $4,000.

(Continued on page 47)

Tenders and For Sale Department

Tenders for
Concrete Pavement

Sealed tenders, addressed to A. H. Millar, City Clerk, will be received up to 5 o'clock p.m., **April 13, 1916**, for the construction of approximately 6,000 square yards of concrete pavement in the City of Berlin.

Plans and specifications can be seen at the office of the City Engineer.

The lowest or any tender will not necessarily be accepted.

HERBERT JOHNSTON,
City Engineer.

Berlin, March 21, 1916. 13-14

Tenders for the Purchase of Scrap Metals Removed from the Parliament Buildings

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for Scrap Metals," as the case may be, will be received until 4.00 P.M., on Tuesday, April 4, 1916, for the purchase of:—

Lot No. 1.—Mostly flat iron, approximate weight	8,000 lbs.
Lot No. 2.—Conduit and gas pipe, approximate weight	800 "
Lot No. 3.—Miscellaneous wrought and cast iron, approximate weight	20,000 "
Lot No. 4.—Wrought iron pipe, approximate weight	7,000 "
Lot No. 5.—Gas pipe and conduit, approximate weight	600 "
Lot No. 6—Galv. iron pipe and wrought iron pipe, approximate weight	1,600 "
Lot No. 7.—Structural iron (straight), approximate weight	12,550 "
Lot No. 8.—Structural iron (twisted), approximate weight	32,000 "
Lot No. 9.—Rod iron, approximate weight	1,000 "
Lot No. 10.—Sheet copper, approximate weight	23,800 "
Lot No. 11.—Brass, approximate weight	100 "

Tenders may be made for either the whole or any number of lots, and must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, for 10 per cent. of the amount of the tender, which cheque will be forfeited if person tendering refuse to implement his tender. Tenders require to be signed in full by the names of the actual tenderers.

The above material can be examined any week day, between 10 A.M., and 4 P.M., on the Parliament Grounds, to the rear of the Parliament Buildings, by applying to the Public Works Officer-in-Charge of the Buildings, Room 21, House of Commons, west side.

Material must be removed by purchaser within two weeks of acceptance of offer.

Purchaser must make cash payment before removing material.

Price per pound to be quoted for the different scrap items.

The Department reserve the right to reject any or all tenders.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, March 20, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—94970. 12-13

Wanted

Experienced Estimators on Plumbing, Heating, Electrical and Sprinkler work. Address Box 378 Contract Record, Toronto, Ont. 12-1

Tenders for
Church Building

Sealed tenders will be received by the undersigned, or by Mr. C. M. Borter, Architect, Niagara Falls, Ont., endorsed "Tender for St. James' Church, Port Colborne," until 6 o'clock p.m., **April 15th, 1916**, for all work in connection with the erection of a stone church at Port Colborne. Plans, specifications and form of tender may be obtained from the architect or the undersigned. The lowest or any tender not necessarily accepted.

E. P. JOHNSON,
Secretary St. James' Church
Building Committee.

13-13

Town of Collingwood
Province of Ontario

Waterworks Extensions

Sealed tenders will be received by the Chairman of the Collingwood Water and Light Commission until 8 p.m. on **Tuesday, April 11th, 1916**, for the following works:—

(1) Pumping Machinery, comprising two motor-driven units, 1,000 Imperial gallons capacity each.

(2) Pump Well and Connections.

Plans and specifications may be seen at the office of the Engineers, 204 Mail Building, Toronto, or at the office of the Water and Light Commission, Collingwood.

The lowest or any tender not necessarily accepted.

HUGH A. CURRIE, Esq., Chairman.
W. B. H. PATTON, Esq., Mayor.
STEPHEN BURNSIDE, Esq., Commissioner.
E. J. STAPLETON, Esq., Superintendent.
CHIPMAN & POWER, Engineers. 13-13

TENDERS
for Electrically Operated Gear

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, April 11th, 1916**, for the supply and delivery of—

	Tender Number
Electrically Operated Driving Gear for operating 36-inch Gate Valves, at Main Pumping Station, John Street	39

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenderers must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman Board of Control

13-13

TENDERS
For a Barn
at the Men's Industrial Farm
ALSO
For a Stable and Waggon House
at the Island

Bulk tenders only, for all trades required in connection with work on the above, will be received by registered post only, addressed to the undersigned, up to noon on **Tuesday, April 11th, 1916.**

Plans and specifications may be seen and forms of tender and all information obtained at the office of the City Architect, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. The usual conditions relating to tendering, as prescribed by the City By-laws, must be strictly complied with, or tenders may not be entertained. Tenderers shall submit with their tender the names of two personal sureties, or the bond of a Guarantee Company, approved by the City Treasurer. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman Board of Control.

13-13

Wanted to Purchase

Ten miles 30-lb. rail with plates. Box 88, Contract Record, 119 Board of Trade, Montreal. 13-13

Wanted to Purchase

Locomotive crane to operate grab bucket. Box 109, Contract Record, 119 Board of Trade, Montreal. 13-13

Locomotive Crane Wanted

Wanted 15 or 20 ton Locomotive Crane, second hand, American make preferred. Must be in good condition. Address Box 376 Contract Record, Toronto, Ont. 12-14

Salesman Wanted

for Montreal district. One acquainted with Engineering and Contracting preferred. Must be of good address, aggressive and resourceful. State experience and salary required. Box 33, Contract Record, 347 Adelaide Street West, Toronto.

Business Buildings and Industrial Plants

(Continued from page 45)

Truro, N.S.
R. O. McCurdy, Willow Street, proposes to build a store and office on Prince Street, and is having plans prepared by L. B. Gray. Estimated cost, $8,000.

Vancouver, B.C.
The Ford Motor Company of Canada have purchased a site at Fifth Avenue and Fir Street for their assembling plant. They will erect a four-storey brick structure. Local Manager, W. G. Patrick.

The Department of Militia & Defence, Ottawa, are making arrangements for the erection of an Ordnance Depot to replace that at Victoria.

Weyburn, Sask.
Work will start soon on the construction of a warehouse on Sixth Street for the Winnipeg Oil Company, Railway Street East.

CONTRACTS AWARDED

Aylmer, Que.
The general contract for the erection of a toll house for the Aylmer Road Company has been awarded to S. Smith, 448 McLeod Street, Ottawa. Approximate cost, $3,500.

Fort William, Ont.
The Mutual Elevator Company, Limited, have awarded the general contract for the erection of an elevator to the Fegles Engineering Construction Company. Approximate cost, $250,000.

Hamilton, Ont.
The contract for excavation and foundations required in the erection of a factory for the Mercury Mills, Limited, 80 Park Street N., has been awarded to W. H. Cooper, Clyde Building.

The Canada Wire & Iron Goods Company, King William Street, have awarded the general and masonry contracts for the erection of an addition to their premises to G. H. Mills, King Street E., and the carpentry to George White, 165 Main Street E. Approximate cost, $3,500.

The general, carpentry and steel work contracts for the erection of an addition to the factory of E. T. Wright & Company, Cathcart Street, have been let to George Conglon, 31 Inchbury Street, and the masonry to Mitchell & Riddell, Head Street. Approximate cost, $4,000.

Montreal, Que.
The general contract for the erection of a block of stores and flats on St. Dominique Street for Miss D. Zudick, 829 St. Urbain Street, has been let to G. Zudick, 829 St. Urbain Street. Brick construction. Approximate cost, $60,000.

The general contract for repairs to the premises of the Canadian Consolidated Rubber Company, Limited, 950 Notre Dame Street E., has been awarded to E. G. M. Cape, Limited, New Birks Building.

W. C. Ball, 310t Verville Street, has commenced the erection of stores and flats on Beaumont Street, and has let the roofing, heating and plumbing to Daniel Kochenburger Frere, 2739 St. Hubert Street. Approximate cost, $6,000.

Ottawa, Ont.
The contract for electrical work required in the erection of a building for Jackson Booth & Syndicate, Metcalfe Street, has been awarded to the Electrical Repair & Contract Company, 317 Craig Street West, Montreal.

Port Arthur, Ont.
The contract for alterations to an elevator for Davidson & Smith Elevator Company has been awarded to the Fegles Engineering Construction, Fort William.

The general contract for re-building the Walsh Block has been let to J. L. McRae, 279 John Street, and the heating and plumbing to the Barnes Company, 243 Park Street.

Quebec, Que.
In connection with the theatre which has been built on Fabrique Street for the Quebec Theatre Company, the contract for painting has been let to Marchant Bros., 122 Artillery Street, and the electrical work to the Quebec Electric Company, 137 St. John Street.

The following contracts have been awarded for the erection of a bank and residence on Ste. Foye Road for La Banque Nationale, 75 St. Peter Street:—masonry and carpentry, general contractors; roofing, E. Falardeau, 143 Dorchester Street; plastering, A. Frenette, 260 St. Cyrille Street; painting, B. Vaillancourt, 92 Sauvageau Street; heating, plumbing and electrical work, Vandry & Matte, 169 St. John Street.

J. B. Laliberte, 145 St. Joseph Street, has awarded the general, masonry and carpentry contracts for the erection of a glove factory to M. Cauchon, 307 Richardson Street. Brick and frame construction. Approximate cost, $5,000.

Work has been started on interior office work for the Canada Steamship Company, 48 Dalhousie Street. The general, masonry and carpentry contracts have been let to L. H. Peters, Limited, 10 Ste. Angele Street, and the painting to J. M. Tardivel, 4 Abraham Hill. Approximate cost, $6,000.

St. Catharines, Ont.
The general contract for repairs to a store for Mrs. McMaugh has been awarded to George Wilson, 16 Wiley Street.

St. Rose, Que.
In connection with the premises being built for the Provincial Bank, Montreal, the contract for plastering has been let to J. Lefebvre, 150 Ontario Street, and the roofing, heating and plumbing to the general contractors.

Sudbury, Ont.
The general contract for the erection of offices, stores and other buildings for F. M. Stafford, Durham Street, has been awarded to the Laberge Lumber Company, Notre Dame Street. Approximate cost, $40,000.

Three Rivers, Que.
The general contract for the erection of an addition to the plant of the Canada Iron Corporation has been awarded to Loomis, Dakin, Limited, St. Gabriel Street, Sherbrooke.

Toronto, Ont.
The general contract for the erection of a garage at the premises of the Sheet Metal Products, Limited, River and Gerrard Streets, has been awarded to Brown & Cooper, 297 Carlton Street. Concrete and brick construction. Approximate cost, $10,000.

The contract for carpentry required in the erection of an addition to the premises of the Carhartt Hamilton Manufacturing Company, 535 Queen Street E., has been awarded to William Bell, 5 Brookmount Road.

The contract for masonry required in the erection of stores and apartments for Rowell & Company, 75 Vaughan Road, has been let to Elliott & Brown, 132 Ellsworth Avenue, and the heating to R. C. Mansell, 85 Quebec Avenue. Approximate cost, $8,000.

Residences

Adolphustown, Ont.
Tenders on the erection of a rectory will be received until April 1st by A. S. Dickinson, R.M.D. Bath, Ont. Plans and specifications with Mr. Dickinson, Robert Wright, R.M.D. Bath, Ont., and H. M. Johnston, R.M.D. Sillsville, Ont.

Chatham, Ont.
Louis Palmer, Patteson Avenue, is now receiving tenders on the erection of a residence, estimated to cost $3,500. Architect, S. G. Kinsey, Fifth Street.

Dundas, Ont.
H. C. Clark, King Street, is considering the erection of a brick residence, estimated to cost $3,000.

Fonthill, Ont.
A. E. Nicholson, 46 Queen Street, St. Catharines, is receiving tenders on the erection of a residence for F. Wellington, in the following types of construction:—(1) brick; (2) stucco on hollow tile; (3) frame. Approximate cost, $10,000.

Halifax, N.S.
John McKay, 2 Lockman Street, is receiving tenders on the erection of a frame residence, estimated to cost $4,500. Architects, Harris & Horton, Keith Building, Barrington Street.

Listowel, Ont.
John Reihm, Wallace Street, proposes to build a residence, estimated to cost $3,000.

The erection of a residence is being considered by Ezra Reihm. Approximate cost, $3,000.

Montreal, Que.
J. Hupe, 156 Duquesne Street, has commenced the erection of three residences, estimated to cost $3,000.

E. L. Judah, 81 Durocher Street, intends to make alterations to a residence at 97 Durocher Street, at an approximate cost of $3,000. Architect, T. Trotter, 28 Fort Street.

Niagara, Ont.
Green & Wicks, 110 Franklin Street, Buffalo, N.Y., are preparing plans of a residence for H. V. Grant, Clark Hill. Estimated cost, $50,000. Stone and brick construction.

Niagara Falls South, Ont.
C. M. Borter, Main Street, is preparing plans of a residence for Ernest Baxter, 5 West Barker Street. Brick and shingle construction.

Oshawa, Ont.
Darling & Pearson, 2 Leader Lane,

Toronto, will receive tender until April 8th for the erection of a residence for R. S. McLaughlin. Estimated cost, $100,000. Hollow tile construction.

Ottawa, Ont.
A. E. Shaver, 45 Powell Avenue, has commenced the erection of a residence, estimated to cost $5,000, and is receiving prices on plastering, painting, heating, plumbing and electrical work.

H. A. Charlebois, 237 Daly Avenue, is about to build an addition to a residence on Osgoode Street.

W. J. Spratt, 157 Sunnyside Avenue, will shortly call for tenders on the erection of a residence, estimated to cost $4,000. Brick veneer and stucco construction.

Oxford, N.S.
The following parties propose to build residences this spring:—James Horton, Arthur Myatt, Frank Myatt, Wilbert Thompson.

Port Lambton, Ont.
David Hinnegan, Lambton Line, propose to build a residence to replace that destroyed by fire.

Quebec, Que.
Tenders are now being received for the smaller trades required in the erection of a residence on Mountain View Boulevard for P. J. Moran. Architect, A. G. Noesworthy, care of V. R. Lamontagne, Quebec Railway Building. Estimated cost, $4,000. Brick construction.

Plans are being prepared by A. G. Noesworthy, care of V. R. Lamontagne, Quebec Railway Building, for a residence to be built for Adelard Dorval. Frame and brick construction. Approximate cost, $4,000.

N. Leblond, 38 Carillon Street, has commenced the erection of a residence, estimated to cost $3,000. Brick construction.

W. Bouchard, 18 Second Avenue, Limoilou, is building a residence, estimated to cost $9,000. Frame construction.

Sawyerville, Que.
G. C. Chaddock proposes to build a residence, estimated to cost $3,000.

Sherbrooke, Que.
Plans of a residence to cost about $15,000 are being prepared by Philip J. Turner, 49 Beaver Hall Hill.

St. Catharines, Ont.
A. E. Nicholson, 46 Queen Street, is preparing plans for alterations and additions to the residence of A. F. Fifield, 157 Ontario Street. Approximate cost, $10,000.

Stirling, Ont.
Rev. Father J. J. Connelly, Trenton, has had plans prepared for a rectory, estimated to cost $8,000. Brick construction.

Toronto, Ont.
E. Elliott, 77 Vermont Avenue, is about to start work on the erection of three residences on Kew Beach Avenue. Estimated cost, $4,000. Frame construction.

Tenders are being received by J. T. Wright, 535 Lansdowne Avenue, for the erection of three pairs of residences on Rutland Street for L. Smith. Brick construction. Approximate cost, $10,000.

H. W. Bowles, 151 Broadview Avenue, is receiving tenders on the erection of a residence, estimated to cost $3,800. Brick construction.

Tuckersmith Township, Ont.
Plans of a residence are being prepared by A. Buchannan, Tuckersmith Township, Hensall. Estimated cost, $3,000.

Ville St. Pierre, Que.
Philip J. Turner, 49 Beaver Hall Hill, Montreal, is preparing plans of two residences.

Zurich, Ont.
Alexander Foster is considering the erection of a residence, at an approximate cost of $3,000.

CONTRACTS AWARDED

Hamilton, Ont.
The following contracts have been let for the erection of four residences on Rosemont Street for Thompson & Thompson, Federal Life Building:—general, masonry, carpentry, stee land roofing, MacKay Bros., 104 Lister Building; painting, T. A. Thompson & Company, 36 Edward Street; heating, H. Day, 34 Huron Street; plumbing, J. Saynor, 173 John Street S.; electrical work, John Dines, 18 Avalon Place. Approximate total cost, $8,000.

McKay Bros., 104 Lister Building, are building two residences on Avalon Place, and have let the following contracts:—painting, T. A. Thompson & Company, 36 Edward Street; heating, H. Day, 34 Huron Street; plumbing, J. Saynor, 173 John Street S.; electrical work, John Dines, 18 Avalon Place. Estimated cost, $2,500 each.

The following contracts have been let for the erection of apartments for J. H. Robinson, 19 S. John Street N.:—general contract, E. & J. Buscombe, Hyde Park Avenue; carpentry and steel work, George Preston, 20 Stanley Avenue; roofing, George Smith, King Street W.; plastering, J. Tramello, Cannon Street E.; painting, A. MacKenzie, 43 Ferguson Avenue S.; heating and plumbing, J. N. Luxon, 60 Leeming Street; electrical work, Synder Bros., 37 King Street W. Approximate cost, $3,000.

Kingston, Ont.
The contract for the erection of a residence for Byron Derbyshire, 163 Union Street, has been awarded to the Kingston Cement Products Company, Patrick and Charles Streets. Approximate cost, $3,800.

Lachine, Que.
The Lachine Land Company, Limited, Dominion Express Building, Montreal, have let the contract for the erection of seven cottages to Valmore Saurette, 197 Galt Avenue, Verdun. Approximate cost, $2,000 each.

Maisonneuve, Que.
In connection with the residences which are being built for M. & O. Dufresne, Ontario and La Salle Streets, the contract for rough carpentry has been let to A. Choquette, 170 Bourbonnier Street, and the mill work to Damien Lalonde Limited, 1,000 Christopher Colomb Street, Montreal.

McKellar Township, Ont.
Bower Bros., 133 Hopewell Avenue, Ottawa, are building a residence on Fourth Avenue, estimated to cost $3,500, and have let the electrical work to E. Headly, 645 Echo Drive, Ottawa.

Montreal, Que.
F. L'educ, 314 Melrose Street, has let the following contracts in connection with the flats which he is building:—masonry, H. Lachance, 1154 Chabot Street; roofing, J. Duquette, 266a St. Catherine Street E.; heating and plumbing, Ernest Labelle; electrical work, Walter Roy, 591 Centre Street.

The following contracts have been let in connection with alterations to a residence on Peel Street for A. P. Stuart, 27 Summerhill Avenue:—brick, C. Lefrancois, 525 St. Emelie Street; cut stone work, John Quinlan & Company, Limited, 4412 St. Catherine Street, Westmount; roofing, heating and plumbing, L. Ducharme & Company, 1995 St. James Street; painting, W. D. Rufiance, 91 Rose de Lima Street.

The contract for heating and plumbing required in connection with the residence being built on Ossington Avenue by Bower Bros., 133 Hopewell Avenue, has been let to Gervin & Lillico, 1095 Bank Street, and the electrical work to G. W. Matthews, 700 Albert Street.

In connection with the residence being built on Oakland Street by Donald Campbell, 6 Driveway West, the contract for plumbing has been awarded to E. Williams, Glenora Avenue, and the electrical work to E. Headly, 645 Echo Drive.

W. A. Cole, 163 Sparks Street, is building apartments on Russell Street, estimated to cost $7,000, and has let the plumbing to E. Williams, Glenmore Avenue, and the electrical work to E. G. Tressider, Third Avenue.

In connection with the residences being built on Irving Street by John Wilson, care of F. Wilson, 793 Somerset Street, the electrical work has been let to H. L. Allan, 373 Somerset Street.

The contract for heating and plumbing required in connection with the bungalow being built by B. A. Grison, 63 Bank Street, has been awarded to J. P. Band, 775 Bank Street, and the electrical work to E. T. Headley, 645 Echo Drive.

Port Credit, Ont.
William N. Allin, 19 Balmuto Street, Toronto, has been awarded the general contract for the erection of a residence, estimated to cost $9,000. Architects, Edwards & Saunders, 18 Toronto Street, Toronto. Stone and brick construction.

Quebec, Que.
V. R. Lamontagne, Quebec Railway Building, has been awarded the general contract for the erection of a residence on Mountain View Boulevard for R. Wright. Approximate cost, $3,500. Smaller trades will be sub-let.

Spirit River, Alta.
McLean & Company are building a frame residence for F. McEwen.

Power Plants, Electricity and Telephones

Edmonton, Alta.
The City Council propose to extend their electric and telephone lines to Beverly, the cost to be borne by the Town of Beverly. Clerk, C. E. Cox.

(Continued on page 50)

Power Plants, Electricity and Telephones

(Continued from page 48)

Grand Valley, Ont.
A by-law has been carried authorizing the construction of a hydro electric system, at an approximate cost of $11,000. Town Clerk, J. A. Richardson.

Sarnia, Ont.
The Town Council and the Hydro Commission are considering a lighting system for the waterfront. Clerk, J. D. Stewart.

Sault Ste. Marie, Ont.
The Great Lakes Power Company have taken over the power department of the Algoma Steel Corporation, and propose to develop 30,000 horse-power. Mayor J. A. McPhail is interested in the proposition.

Toronto, Ont.
The Toronto Hydro Electric Commissioners, 226 Yonge Street, will receive tenders until April 4th for the laying of cable ducts and constructing manholes and transformer vaults. Specifications at office of the Purchasing Agent, 15 Wilton Avenue.

The Commissioners are also having plans prepared for the following work:—sub-station on Jefferson Avenue, $8,000; addition to Front Street Station, $6,000; addition to Stanley Park Sub-Station, $12,000.

Vancouver, B.C.
The British Columbia Telephone Company, Vancouver, intend to construct copper circuits between New Denver, Kaslo and Nelson, and separate circuits from Nelson to Rossland and Midway to Penticton.

CONTRACTS AWARDED

Davin, Sask.
The Davin Rural Telephone Company have awarded the contract for the construction of their system to Brander & McGuay, Regina, at $8,890. Contractors require material.

Fires

Albert, N.B.
Residence of Frank Geldart totally destroyed.

Bromptonville, Que.
Factory of the Model Dress Company. Loss, $25,000.

Residence of O. Lambert entirely destroyed.

City View, Ont.
Residence of John Daoust, Raden Avenue. Loss, $3,500. May rebuild.

Residence of S. Cousineau, Raden Avenue. Loss, $4,000. May rebuild.

Glencoe, Ont.
Store owned by C. Dean, Main Street. Loss, about $10,000.

London, Ont.
Work shop at Asylum on Dundas Street, owned by Provincial Department of Health. Loss, $5,000. Will be rebuilt.

Moncton, N.B.
Store owned by Duncan Brace, Railway Avenue, totally destroyed.

Montreal, Que.
Factory of the Canadian Rubber Company. Loss, $50,000.

Quebec, Que.
Bowling alley owned by L. A. Cannon, 2 Ferland Street. Loss, $10,000.

Raymond, Alta.
Cafe and store owned by Charles MacCarty totally destroyed.

Regina, Sask.
Roundhouse of the Canadian Northern Railway, Toronto. Loss, about $15,000.

St. George, Ont.
Agricultural plant owned by B. Bell & Sons. Loss, $10,000.

St. John's, Que.
Furniture factory of D. H. Langlois & Company. Loss, $16,000. Will rebuild.

Miscellaneous

Cottam, Ont.
J. A. Jackson, contractor, is in the market for cement, weather strips, lumber, wood paint, asphalt shingles and screens.

Hurdville, Ont.
James Hardie is in the market for three saw edger and portable sawmill machinery, as well as a 40-h.p. boiler.

Kingston, Ont.
The City Engineer, R. J. McLelland, will receive tenders until 5 p.m., April 3rd, for the supply of 300 tons, more or less, of refined asphalt, f.o.b. Kingston.

Ottawa, Ont.
Tenders will be received until April 3rd by William Kearns, 110 Wellington Street, for hardware, lumber, cement and sand required by the Ottawa Improvement Commission.

Quebec, Que.
The City Engineer, W. D. Baillairge, will receive tenders until April 5th for the supply of broken and unbroken stone, sand, deals and nails.

St. Thomas, Ont.
Horton Brothers are receiving prices on brick, sheet glass, skylights and ventilators.

Westmount, Que.
Tenders will be received until noon, April 5th, by the City Secretary, A. F. Bell, on the supply of the following materials:—cement, sand, crushed stone, sewer pipe, quarried stone, farm tiles, brick. Engineer, P. E. Jarman.

CONTRACTS AWARDED

London, Ont.
The City Council have let the following contracts for supplies:—iron castings, Owl Manufacturing Company, Ltd., 351 Glebe Street; gravel and screenings, G. Alexander, 516 Piccadilly Street; cement, W. Buchanan, Bank of Toronto Building; vitrified tile, William Copp, 93 York Street.

Montreal, Que.
The City Council have awarded the contract for the supply of 6,000 tons of refined asphalt to the Warner-Quinlan Asphalt Company, 745 St. Catherine St. W., at $19.33 per ton.

Ottawa, Ont.
The City Council are having plans prepared for laying creosoted wood block and asphalt pavement on Dalhousie St. Tenders will be called early in April. Estimated cost, $12,000. Engineer, F. C. Askwith.

Late News Items

Huberdeau, Que.
The hotel owned by O. Duclos has been totally destroyed by fire. Loss, $25,000. Owner will rebuild.

Leamington, Ont.
The Town Council have let the contract for laying concrete pavements on Mill and Erie Streets to F. Smithson, care of the Town Clerk, R. M. Selkirk. Approximate cost, $15,000.

London, Ont.
A. E. Nutter, Dominion Bank Chambers, is preparing plans for two residences, estimated to cost $8,000 and $6,000 respectively.

Montreal, Que.
Alexander McKay, 498 Argyle Street, is building a block of flats on Addington Street and another on Minto Street, estimated to cost $15,000 each. Contracts will be let for marble and tiling work.

Napanee, Ont.
The Town Clerk, W. A. Grange, will receive tenders until April 3rd for supply of the following materials during the year:—pine plank, nails, stone, broken stone, rubble, gravel, cement and sewer tile.

Ottawa, Ont.
In connection with the erection of an addition to an office building for Blackburn Bros., Union Bank Building, the contract for steel work has been let to the Dominion Bridge Company, Sparks Street. Tenders on painting, heating, plumbing and electrical work will be called by the Architect, W. E. Noffke, Plaza Building, Rideau Street.

Port Colborne, Ont.
Tenders on the erection of St. James Church will be received until 6 p.m., April 15th, by the Secretary, E. P. Johnson, or the Architect, C. M. Borter, Main Street, Niagara Falls South. Approximate cost, $15,000.

Regina, Sask.
The City Council have awarded the contract for supply and installation of an electrically driven pumping plant at Bogg Creek to Fraser and Chalmers of Canada, Limited, 59 Beaver Hall Hill, Montreal. Approximate cost, $12,000.

St. Andre D'Acton, Que.
The contract for concrete work required in the construction of a bridge for the Municipal Council has been awarded to Grise & Houle, St. Christine, Que., and the steel work and flooring to the Dominion Bridge Company, 145 St. James Street, Montreal.

Three Rivers, Que.
In connection with the factory which is being built at St. Roche and St. Marqueret Streets for the City Council, the contract for heating, plumbing and electrical work has been awarded to N. Dechene, 106a Desforges Street, at $13,000.

Whitby, Ont.
Robert Hutchison, Public School Inspector, will receive tenders until April 15th, for the erection of a residence, estimated to cost $6,000. Architects, Barber & Tilley, Temple Building, Brantford.

ESTABLISHED 1886

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Principal Contents

An Agreeable Surprise

THE business men of Toronto have been agreeably surprised by the action of their city council in appointing Mr. Thomas Bradshaw as head of their finance department. The surprise is intensified by the facts that Mr. Bradshaw did not seek the position, is not a politician, was not even the subject of a largely signed electors' petition or delegation and, finally, is well suited by training, experience and ability for the work.

The salary naturally was some considerable bone of contention among certain of the aldermen but even on this point there was surprisingly little hesitation. The chances are that Mr. Bradshaw will save his salary many times over to the city each year. We have only to recall a comparatively recent sale of City of Toronto bonds where the price obtained was too small, it was charged, by somewhere between a quarter and a half a million dollars. The employment of novices in work of this sort is not true economy.

The only possible objection that the appointment of Mr. Bradshaw seems to be open to is that heads of some of the other departments will immediately begin to pull wires and get their machinery oiled for agitation to even salaries up. They will forget that Mr. Bradshaw is being paid this amount because he is worth that much to the city. They will forget, some of them, that they are already paid all, and much more than all, they are worth to the city. We hope the Toronto city council, having done a really commendable act and shown good judgment, will continue in the way of discriminating between men who are capably holding their positions and those who are just capably holding on.

The City Beautiful

SYSTEMATIC organization by municipal authorities of a spring "clean-up" campaign is being more widely extended each year. The movement has received valuable assistance by the information gathered and published by the New York State Conference of mayors and city officials in their report on Municipal Clean-Up Campaigns, extracts from which are printed in this issue. "Clean-up" week has in recent years become increasingly popular as a means of beautifying the city and in stimulating civic pride in the cleanliness and safety of the home and the development of public affairs. Upwards of three thousand cities in the United States and Canada take an active interest in a "clean-up" week, and the methods employed by the different cities are many and varied. The value of the press cannot be overestimated as a factor in the clean-up movement. By means of announcements, editorials, cartoons, advertisements, etc., it can probably interest a larger number of people than any other agency. Insurance companies and civic improvement organizations do a great deal by their co-operation in the movement for sanitary laws and conditions.

Clean-up time generally comes some time during April or early in May, and in most cities extends over a period of two weeks, with a regular programme for each day of that period. The mayor of the city or town usually appoints a clean-up week committee who adopt some plan of action and appoint sub-committees and divide the work among district organizations. Publicity is then given to the campaign through newspaper bulletins, circulars, posters, moving pictures, private advertising, etc. Motion pictures are a valuable medium of bringing before school-children and citizens the ravages of the fly and actual conditions existing from unsanitary conditions. One of the greatest factors in a clean-up campaign, to make it a success, is the co-operation of the school-children. One of the best means of reaching the adults is through the children, and the education of the children themselves along these lines will contribute materially to their sense of proper community conditions when they grow up. Lectures on home and community gardens and the benefits to be derived from a cleaner and more beautiful city, with prizes for the best-kept yard, aid very considerably in furthering the campaign.

The good effects of clean-up week have been so universally recognized that some cities have crystallized the movement into an ordinance, making it unlawful to deposit within the city limits rubbish of any description. A tour through any city after "clean-up week" would convince the most incredulous that in promoting this movement municipalities have materially lessened their fire risk and improved their sanitary conditions. Some of the good results conceded to a "clean-up" campaign are—improvement of housing conditions, reduction of fire loss, elimination of unsightly lots, stimulation of civic pride, and the development of the community spirit in a movement for improved public welfare.

Change of Name

The Regina branch of the Canadian Society of Civil Engineers, recently organized, are considering the advisability of changing their name to the "Saskatchewan Branch" so that it may be more apparent that all members of the engineering profession in that province are members of the C. S. C. E. and included in the organization. The following letter is being sent out to Society Members throughout the province by the secretary of the Regina branch and is self-explanatory:

Dear Sir:—Only a few months ago the Members of the Canadian Society of Civil Engineers residing in Regina and its vicinity followed the example of nearly all eastern cities and most of our western centres in forming a branch of our Parent Society here. During its short existence, it has proved a valuable medium of professional intercourse, giving an opportunity of meeting representatives of our profession in its many different branches of work.

While it is true that we all belong to one Society, yet the considerable distance which separates the members residing in Saskatchewan from the headquarters at Montreal prohibits a very active and personal interest being taken by them in the affairs of the Society and therefore decreases considerably the service and usefulness of our Society. In order to overcome this difficulty and to give our members living in this Province a centre for periodical meetings for the exchange of their views on various professional subjects and eventually perhaps for the formation of a small provincial Library, etc.—it is the intention to follow the example of the Branch at Winnipeg and to extend our scope, so as to include all members residing in Saskatchewan. We propose therefore with the support of a majority of those members to change our name into "Saskatchewan Branch."

The undersigned Secretary therefore would thank you to advise him as soon as possible of your views on the subject.

Sgd. J. H. deStein,
Secr.-Treasurer Regina Br.

Make Specifications Clear

Recently the Montreal Catholic School Commissioners rejected a tender for the erection of a school on the ground that the person tendering was not a citizen or ratepayer of Montreal. The Montreal Builders' Exchange has taken up this matter and in a letter addressed to the Commissioners point out that the advertisement calling for tenders contained no stipulation of any kind; consequently it was expected all tenders would be considered and adjudged on their merits. "My board, however," says Mr. D. K. Trotter, the secretary of the Exchange, "were surprised to learn that at the meeting at which tenders were opened the question was raised whether certain of the tenderers were or were not citizens and ratepayers of the city of Montreal. I have been instructed to suggest that in future advertisements calling for tenders, your board should specify clearly and definitely the class of contractors whose tenders will be accepted. Should your board, however, persist in the method I have referred to the Builders' Exchange is advised that this will tend to discourage reputable firms from tendering on future work, and thus deprive your board of some of the benefits to be derived from competitive sealed tenders. You, of course, are well aware that when any general contractor submits a tender to your board, money and time have been consumed in its preparation, and there is no apparent reason why this work should be done without an opportunity being afforded of having its merits tested alongside its competitors." The Exchange asks that in future advertisements the Commissioners should define more specifically the conditions on which tenders will be considered and accepted.

Toronto Harbor Work

It is understood that the Toronto Harbor Commission will spend $700,000 in connection with this summer's work. The work started by the Government in Ashbridge's Bay and the Humber Bay will be completed, and in addition the transformation of the old harbor and water-front will be proceeded with. An order-in-council has been passed at Ottawa establishing a permanent headline in the Toronto harbor between Bathurst Street and a point opposite Yonge Street.

The plans provide for the establishment of seventeen acres of industrial area at the foot of Bathurst Street, which will be served by 800 feet of dock and 20 feet of water. There will also be modern freight sheds and factory buildings. In connection with the extension of the pier-head and bulkhead line, the C. P. R. and G. T. R. have waived their riparian rights to water lots between Bathurst and John Streets, and will join the Commission in application to the Government for approval of the new lines.

Edmonton Branch C. S. C. E.

Through the courtesy of the National Electric Light Association of New York City, the Edmonton Branch of the Canadian Society of Civil Engineers had the opportunity of showing a series of lantern views of the Panama Pacific Exposition at their regular meeting on Friday evening, March 24th. These views showed very clearly the wonderful lighting effects secured by the Engineers in charge of the illuminations at the Exposition. The chair was occupied by Mr. G. H. V. Bulyea, Chairman of the Public Utilities Commission for Alberta. The Lecturer for the evening was Dr. J. A. Allan, of the University of Alberta, who spent Some four weeks at the Exposition.

Toronto Branch C. S. C. E.

The regular monthly meeting of the Toronto Branch of the Canadian Society of Civil Engineers will be held in the Chemistry and Mining Building of the University of Toronto on Thursday, April 13th, 1916. Professor A. P. Coleman, Ph.D., will give an illustrated address on "A Visit to the Mountains of Northern Labrador."

Shall I Build Now, or Wait? Comparative Prices Today and at Outbreak of War

Does it cost more to build to-day than it did at the outbreak of war? This is the question repeatedly and persistently asked almost daily of the contractor, the architect and the manufacturer. Is the price of materials higher? Is labor dearer? Shall I build now or wait?

This is, in reality, a more complex problem than may appear on the surface and the answer is not easily found. One of the biggest difficulties is that conditions vary greatly with different buildings. Plainly, much will depend on the type of construction. For example, a building in which brick bulks large will benefit more by the low price of that material than one to be constructed chiefly of stone or steel. The most apparent fact of the whole situation is that the variation in the prices of the things that go to make a building has not been uniform. This will probably mean a readjustment of plans in many cases. Quite often, no doubt, it will be found that certain material, which ordinarily would be specified, has increased in price correspondingly more than another material that will serve the purpose almost equally well. This might lead to a re-planning of the whole structure. It is evident then that instead of the owner planning his building to-day on the basis of a couple of years ago he will do well to consider the trend of prices in the meantime and so determine whether some other type of construction formerly more expensive may not now have become more economical.

The subject of varying prices in building materials looms up so prominently on the construction horizon to-day, and the question is raised so frequently, that it has occurred to us that possibly a more or less comprehensive review of the price situation, as it affects the different elements of the building trade, might prove of interest and value to our readers. With this in mind we have been endeavoring to collect, from many sources, during the past few weeks, comparative figures and prices now and, say, a year ago or at the outbreak of the war. These figures we are now placing at the disposal of our readers in the hope that they may prove helpful. The quantity of material collected makes it almost necessary that we should spread it out over more than one issue. This week we are dealing more particularly with what may be considered the coarser construction materials and, generally speaking, those which represent the largest percentage of the cost of building, namely: stone, brick, cement and lime and sand. In following issues it is our purpose to deal with other more or less closely associated groups.

Stone

The price of building stone and sand is practically the same as it was in 1913—if anything a little easier—and quarry owners report that unless the labor situation becomes more acute they do not look for any immediate advance in prices. The cost of imported stone has been increased by the extra war tax, which amounts to three cents per cubic foot, but this is apparently offset by the keener competition which is the result of the slowing up in building operations. It is a peculiar fact that the price of stone has remained practically the same during the last decade, no doubt due to the improved machinery and equipment for quarrying which, to a large extent, offsets the increased labor cost. Crushed stone also stands today at the same price as at August 1, 1914. Approximately a year ago lower prices, from 10 to 15 per cent., were quoted for crushed stone but it has recently been found necessary to re-establish the former prices. Rubble stone has been unchanged throughout.

Brick

Without doubt, of the larger industries, brick has been hit harder by the war than any other building industry. The manager of one of the largest brick works in Canada writes us that their "prices to-day are fully twenty-five per cent. less than prices received previous to the outbreak of the war." Another manager writes us of a case where brick is being delivered on the job about two miles from the brickyard at $7.50 per thousand. This is for a kiln run stock of brick that would have cost at least $9.50 in 1913 and from $10.50 to $12.00 in 1911. It will thus be seen that prices on common brick are away below what they have sold at for several years. The price of face brick is probably about $2.00 less than at the outbreak of war.

It must be understood that these are conditions apparently brought about by many of the works being over-stocked when war broke out and that present prices result from their determination to keep their businesses going at almost any cost. With any considerable increase in building it is believed that prices are due for an advance anywhere up to 20 per cent. As there is unmistakable evidence of much greater building activity this year than in 1915 the advice of one manufacturer to prospective buyers "buy their material at once if at all, otherwise they will be unable to take advantage of the prevailing low prices" would seem to be sound and worth heeding.

Cement

The price of cement has varied from constant to about ten cents lower. One western Ontario firm places the reduction at 15 cents a barrel since the war broke out. It is pointed out, however, that the demand has been less than half of normal and that this reduction will not likely hold as soon as the demand increases. So far as cement is concerned there are many reasons why building should go forward this year. In the use of concrete in buildings or elsewhere a large percentage of the men on the job are unskilled laboring men who, at the present time, need work and are willing to work at the same or even reduced wages. This is probably more true in the province of Quebec than elsewhere. This means that concrete construction can be carried out at a lower price than was possible during 1913, 1914 or 1915. In no case have we been quoted an increased price for cement, though it is frequently pointed out that all indications are that prices of building materials will advance owing to a possible scarcity of labor, increased demand for buildings, and the uncertainty of the price of coal.

Lime

Lime also has stood at exactly the same price for the last two years. One dealer quotes us 38 cents per hundred pounds on August 1, 1914, March 1, 1915, and March 1, 1916. Neither in bulk or in the hydrate form has there been any increase in price whatever.

It is evident, therefore, that so far as these four items are concerned building may be carried on during the present year, providing today's prices are maintained, at a cost may be 10 to 20 per cent. less than last year or the year before. The importance of the figures discussed above will of course depend on the percentage of the total cost of the building which these four items represent which, as already pointed out, will vary greatly with the type of building to be erected. There is evidently no change in price in immediate prospect, with the probability, in case of any change at all, that prices will increase.

The Engineer in Peace and War — The Increasing Value of Trained Men

At a sacred and patriotic concert, organized by the Ottawa branch of the Canadian Society of Civil Engineers, held in the Dominion Theatre, on March 26, Mr. Walter J. Francis, of Montreal, read a paper on "The Engineer and the War." After a reference to the relation of the engineer to the normal conditions of the present day life, Mr. Francis alluded to the part Sir P. Girouard played in the Soudan and South African wars. Col. H. S. Greenwood and Mr. A. F. Stewart, both of the C. N. R., also took a leading part in the Boer war. He proceeded:

"The Right Honourable David Lloyd George, the Minister of Munitions, in a speech delivered last summer is reported to have said that the present war is a terrific contest between engineers of the warring nations. The object lesson so tragically taught by Germany has aroused the other nations of the world to a keen appreciation of the result of the application of engineering energy to military purposes. While Germany was, as we all think, so misapplying a great part of her engineering talent, the other nations had been devoting their efforts to the development of the arts of peace. We have been forced to meet the exigencies of the situation, and to our military engineers and to the engineers in civil life has fallen the task of overtaking Germany's forty years of preparation not only on the fields of battle, but in the workshops at home. Two of the most eminent military engineers of the world are in foremost places—Lord Kitchener and General Joffre.

A Cold, Calculated Programme

"The war is an immense work of cold, calculated programme. Let us draw an analogy. A building contractor, let us say, determines to carry out a piece of work in a certain time. He calls his superintendent and explains what is to be done and when it is to be finished. The superintendent in turn calls his foremen and the various interests to whom he looks for co-operation and assistance. The materials are ordered. The laborers and artisans start their work—and the work is completed according to the wishes of the master mind. It is all a matter of mature forethought and cold calculation. There is nothing of accident or haphazard trust-to-luck haste. It is all carefully thought out ahead. The proceedings in the war are quite analogous, only on a stupendous scale. Nothing happens by chance. The constant care is to be in readiness at the necessary or appointed time. I would not modify my analogy but would point out that Germany stands in the position of a contractor with an organization complete and ready, while the Allies have to be likened to one who may be without any organization and have to build it up. Thank the Lord, King Albert and the Belgian engineers and the engineers of France and the British Navy were partly prepared, or we should not have the privilege of discussing the subject this evening.

Lt.-Col. Charles H. Mitchell, G.S.O.

"There was one at least of the Canadian engineers who specially prepared himself in his spare hours for the service of his country in time of need, and I hold in my hand a card received from him not long since. He is a close friend of a number before me and an acquaintance of very many not only in Canada but in Europe—I refer to Lt.-Colonel Charles H. Mitchell, General Staff Officer in charge of the Intelligence Department of the Canadian Army Corps in France. It happens to be a card of felicitation, and he starts out "All goes well at this end." Later he proceeds, "The nice feature about my work is that after all it's pretty much the same in its type as consulting engineering—in fact is the same if you substitute the Huns for the forces of nature." Colonel Mitchell's reference is, of course, thoroughly well understood to many of you, but for the uninitiated let me explain that there is a definition of engineering which describes the engineer as one who deals with the forces of power in nature. Colonel Mitchell finds that the process of handling is the same, only instead of dealing with water powers and all the rest of it his problems are with the enemy. In a letter just received he says, "It is strange and yet very fortunate what an analogy there is between this work and my own professional work at home. The general character of the work, hours, life and thought is similar, the assistants similar and one's activities are quite the same—office work, reports, analysis, correspondence, direction of investigations, deductions, maps, outside tours of inspection, constant telephone activity—all the same if you substitute the enemy for the forces of nature. There is a difference, though. It is seven days a week from 9 a.m. until 11 p.m." The Colonel goes on "Our headquarters are in the Hotel de Ville of this little city (about 12,000 people normally) and it is really quiet and peaceful if one gets used to the passing to and fro of thousands of men and hundreds of motor lorries, motor cars, wagons, and so on, in the day, and the recent aeroplane activity by the enemy, in which he has been dropping bombs on various parts of the town, railway station, flying aerodrome locality, and not forgetting the cemetery. I had the misfortune last Sunday to lose one of my best draughtsmen, killed on the street on his way to a noonday meal." All this is a specific up-to-the-minute statement from an intimate friend at the front, who went to the front at the start, won the Distinguished Conduct Medal at Langemarck and has since been decorated with the Legion of Honour of France.

Railway and Forestry Corps

"Canada is to be congratulated on the special services required of her soldiers. Like Sir Percival Girouard, Colonel Ramsay of the C. P. R., has been called to the front with a corps of railway constructors, every man a specialist in a particular branch of railway construction. He has since been followed by a second corps, and now other engineering parties are being called for to render special services at the front. One of the most unique of these parties is one armed with broad-axes and recently inspected by His Royal Highness in this city. In Flanders we can see them performing their task fearlessly and faithfully. Under the fire of the enemy they unflinchingly construct their bridges and prepare their highways. With tireless energy they minister to the needs and convenience of the men in the trenches. Anywhere, everywhere, their services are required and the special skill stands them in good stead, for it must be remembered that in these bodies of men are artisans of all classes. Let me quote you some of the classes required by the engineer corps now being recruited by Captain Charlebois: bricklayers, carpenters, draughtsmen, mechanics, masons, wheelrights, shoemakers, clerks, drivers, chauffeurs, saddlers, plumbers and tailors. In this connection you will doubtless have noted the similarity between these organizations and the work of the engineer in private life. To every engineer there are many assistants all the way through the various grades to ordinary labor.

"The Canadian Society of Civil Engineers, of which the Ottawa branch is such an important part, has nearly five hundred of its members on the field of honor, and some have made the supreme sacrifice. We all congratulate the Ottawa branch on the fact that it is taking a systematic military engineering course.

The Struggle at Home

"This reference naturally leads me to the fact that the whole of the struggle is not on the battle fields nor indeed in Europe. Soldiers must not be without ammunition. At the outbreak of the war nobody in Canada knew how to make ammunition on a commercial scale. Metal manufacturing industries were paralyzed by the interruption of normal conditions. The Allies needed shells. The Canadian manufacturers in a body rose to the occasion and transformed the shops of the Dominion into shell factories. The speed with which this transformation was accomplished probably stands without a parallel in the history of manufacturing. The Government appointed as the head of a commission an engineer whose knowledge of the machine shops of Canada had been gained from a lifetime in the work following his father and in a few months the shops of Canada had learned their lesson and were exporting shells to the Allies. In recognition of his services Alexander Bertram was knighted by His Majesty King George at the New Year.

"The celerity with which new methods, new processes and accurate measurements were put into practice is a standing monument to the skill of Canadian manufacturing engineers. Let me by a few figures illustrate the transformation which has taken place in one shop alone. Prior to the war this engineering firm employed about twelve hundred men and had a daily output valued at about $30,000. To-day the employees number five thousand men and the value of the daily output is $200,000. It is a significant fact that the President of the Canadian Society of Civil Engineers, as well as two of the immediate Past-Presidents, are all directly or indirectly engaged in the manufacture of ammunition.

The Future

"Naturally from the present conditions in Canada we pass to the thought of the future. When the war is over and when German militarism will have been crushed, what of Canada? Already a new word has been coined in the United States, 'preparedness.' President Wilson recently said 'there may come a time when I cannot preserve both the honor and the peace of the United States,' and the outcome of this movement has been the appointment of a consulting board of specially chosen engineers, composed principally of the representatives from the five foremost engineering institutions of the United States, the American Society of Civil Engineers, the American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Mining Engineers, and the American Chemical Society. Its immediate work will be to make an inventory of the facts necessary to be known to the army and navy relating to the resources of the nation for the supply of munitions of war in case of need. The French Republic has organized a similar civilian board and has raised it to the dignity of a ministry, 'Le Ministere des Inventions.' Great Britain has also enlisted the services of civilian scientists and technologists with a view to the development of the utmost of the nations' industries for the prosecution of the war.

"Meanwhile the world struggle is becoming fiercer. The engineers in civil life must attend to the production and the transportation. The mines must be kept producing the raw materials, and the factories the finished products. The railways and the steamships and the motor cars must take them to the front, where the military engineers amidst the inferno of shell and machine gun fire are doing their part under the old motto of the Royal Engineers? 'Ubique,' 'Everywhere,' and continuing the fight led by the stirring war cry, 'Quo fas et gloria ducunt,' 'Where right and glory lead.'"

The Toronto and York Highway Commission's Specifications for Road Tars

The specifications given herewith are those used by the Toronto and York Highway Commission, and have been prepared by Mr. E. A. James, of James, Loudon & Hertzberg, chief engineer of the Commission.

For a number of years tar products have been used by the York Highway Commission, and these specifications represent what is considered by Mr. James the products best suited for urban and suburban road work.

The light tars may be used as dust preventives where there is a predominance of iron tired traffic.

The medium tars are well suited for blanket covering of water-bound macadam roads where there is heavy rubber tired traffic.

The heavy tars are suitable for bituminous-bound macadam roads by either the penetration or the mixed method.

Specifications for Coal Tar Cement for Road Purposes

The following specifications cover the requirements of the Toronto & York Highway Commission for 1916 delivery.

The tar products required by the York Highway Commission will fall into three general grades:—

(I.) Light Tars.
(II.) Medium Tars.
(III.) Heavy Tars.

Material

(1) The tar cement shall be a residue of the distillation of coal tars only, and shall be refined for the special purpose of making a paving cement.

(2) No mixture of hard pitch with the lighter oils of coal tar will be permitted.

(3) It shall be uniform in its grade as to its physical characteristics and chemical composition.

(4) It shall not contain over 0.5 per cent. of water soluble materials.

(5) The product shall be free from water as determined by distillation.

(6) The product shall show complete ignition in more than 0.5 per cent. of inorganic matter.

I. Light Tars

The specific gravity shall not be less than 1.10 nor more than 1.20 at 60 degs. F. The viscosity tested by the standard Engler viscosimeter shall not be more than 250 sec. or less than 100 sec. for 100 c.c. at 104 degs. F. On distilling 100 grams of the material to 337 degs. F. not more than 10 per cent. shall distill over. On containing the distillation to 600 degs. F. the residue shall not be less than 65 grams. This residue shall be a soft pitch at 60 degs. F. If the residue appears hard it shall be tested for melting point and the melting point shall not exceed 140 degs. F. by the ½ inch cube method in water. The specific gravity of the entire distillate shall be not less than 1.01 at 60 degs. F. The free carbon shall be not less than 4 per cent. nor more than 12 per cent.

II. Medium Tars

The specific gravity shall be not less than 1.18 or more than 1.28 at 60 degs. F. The viscosity tested by the standard Engler viscosimeter shall be not less than 125 sec nor more than 200 sec. for 100 c.c. at 212 degs. F. On distilling 100 grams of the material, no distillate shall come over below 328 degs. F. On continuing the distillation to 600 degs. F. not more than 25 per cent. of distillate shall come over. The specific gravity of the entire distillate shall not be less than 1.03 at 60 degs. F. The residue from the foregoing distillation shall have a melting point not greater than 165 degs. F. The free carbon shall be not less than 12 per cent. nor more than 24 per cent.

III. Heavy Tars

The specific gravity shall not be less than 1.22 or more than 1.30 at 60 degs. F. The material shall have a melting point, determined by the ½ inch cube method in water of not less than 100 degs. F. nor more than 110 degs. F. On distilling 100 grams of the material, no distillate shall come over below 338 degs. F. On continuing the distillation to 600 degs. F. not more than 15 per cent. of distillate shall come over and the specific gravity of the entire distillate shall be not less than 1.03 at 60 degs. F. The residue from the foregoing distillation shall have a melting point not greater than 165 degs. F. The free carbon shall be not less than 12 per cent. nor more than 25 per cent.

Delivery

The material will be delivered by the manufacturer, freight prepaid at any siding in York County at a price per Imperial gallon (railway weights not accepted). Measurement to be made when tar has a temperature of 77 degs. F.

Payment

Eighty per cent., thirty days after delivery. The balance sixty days after delivery upon the estimate of the engineer. In all cases payment will be withheld until a certificate has been presented showing the grade of the material and that it is according to specifications. If the material is according to said specifications said certificate will be supplied within the payment dates.

Price per Imperial gallon:—		Brand
In carload lots	Cents	....
....	Cents	....
....	Cents	....
In five barrel lots..........	Cents	....
....	Cents	....
....	Cents	....
On the Road	Cents	....
....	Cents	....

The Commission is to sweep the road and later supply the sand.

Name of Company ....

Address ....

Location of Plant ....

The Deterioration of Creosoted Wood Block Pavements

The following article is based on a paper presented before the American Society of Municipal Improvements at a recent convention in Dayton, Ohio. The paper contains a collection of data gathered from an extensive investigation of existing wood block pavements.

Heretofore, discussion of wood-paving block specifications have been largely theoretical. These discussions have dealt with the relative advantages or disadvantages of straight coal-tar creosote, additions of refined coal tar to creosote, water-gas tars, etc.—theories unsupported by experience and clouded by a general lack of knowledge as to what the various terms meant; even at the Dayton convention there was a difference of opinion as to just how to define commercial creosote.

Actual Experience With Creosote Preservatives

A study of European specifications for wood-preserving oils has likewise shown wide variation in requirements, but at the same time uniformly satisfactory results. All these specifications, however, distinctly require that the oil shall be a coal-tar creosote derived from strictly pure coal tar. European experience has further shown that any good creosote derived from pure coal tar injected in proper quantities into sound seasoned timber protects the timber from decay for 25 or more years. The particular percentage of naphthalene, tar acids, etc., appears to have very little to do with results.

The results of examinations clearly show that in the majority of cases—practically universally—failures and defects in streets paved with creosoted yellow-pine blocks could be attributed to improper laying, poor foundations, omission of expansion joints, want of proper drainage, etc. Failures caused by decay of the blocks were far less numerous, and such failures were usually in comparatively old pavements.

Very thorough examinations were made of two wood-paved streets in St. Louis, Mo. In addition to removing many of the decayed blocks a careful examination was made of the sound blocks in the immediate vicinity of those decayed. Oil was extracted from the sound blocks and analyses made, which were compared with the analyses of the oils originally used. On both streets what are usually known as extremely light oils were used; one showed evidences of petroleum adulteration.

The causes of failure in these blocks are laid to one or more of the following: (1) Insufficient amount of oil; (2) poor penetration, particularly of the sapwood; (3) use of oil containing petroleum compounds instead of one of strictly coal-tar origin; (4) insufficient absorption due to high water content in the sapwood; (5) use of a very light naphthalene-containing oil, a large percentage of which had evaporated from the blocks.

None of the blocks treated with a straight coal-tar oil showed decay in any of the sapwood which still contained the preservative, which could not be said of the blocks treated with the oil containing petroleum.

Similar examinations were made of streets in Toledo, Ohio, which served to indicate even more strongly than those in St. Louis that the two factors—poor quality of oil (that containing petroleum additions) and insufficient penetration—had in all probability caused the failures. The failure of blocks in a pavement in Charleston, S. C., was traced to the use of a straight water-gas oil and very poorly penetrated blocks. Efficient penetration depends on the condition of the timber—its water content and soundness; on the character of the wood treated; on the volume of oil injected; to a slight degree on the character of the oil used—that is, the percentage of insoluble matter; and on the temperature employed during the treating process.

In treating paving blocks the absorption and penetration are determined by two factors—(1) The individual characteristic of the piece of wood to be treated, that is, the natural density and the percentage of water contained in the individual stick, and (2) the volume of the oil injected.

The densest piece absorbs the least quantity of oil, the most porous piece the highest quantity, when both are treated in the same charge under the same conditions. Pieces with high water content absorb less oil than those with low water content. A charge into which an average of 20 lb. per cu. ft. of creosote is injected shows better penetration than one in which only 10 lb. per cu. ft. is injected.

In order to determine the law of penetration for paving blocks, a number of experiments were made, using both a solution of coal tar and creosote oil and a straight creosote oil. Five different tests were conducted, each at a different treating plant. In each case 100 paving blocks, picked at random, were carefully weighed individually before treatment. Each block was carefully numbered for identification.

These 100 blocks were treated in a regular charge, and immediately after the treatment the blocks were weighed again, to determine the amount of oil absorbed. The results of these five tests were plotted on diagrams. There were two diagrams for each test, one set showing the variation in absorption in the 100 blocks, without relation to the weight of the individual blocks before treatment. At the bottom of the diagram two scales were given, the lower one showing the number of ounces absorbed, the upper showing the number of pounds per cubic foot. Individual crosses were used to show the number of paving blocks which absorbed the quantity of oil indicated by the figures at top and bottom.

A study of these charts shows that no matter what kind of oil was used, no matter at what plant the blocks were treated and irrespective of the condition of the timber at the time of treatment, there was a small number of blocks in each case which absorbed a comparatively small quantity of oil. Similarly a small number of blocks absorbed a comparatively large quantity of oil, and between these two there were various degrees of absorption; but the largest number of blocks invariably fell near the point which gives the intended average absorption.

The other set of charts shows the relation between the weight of individual blocks and the amount of oil absorbed per cubic foot in those blocks. These charts also show that irrespective of the kind of oil used or the kind of timber, there is a definite relationship between the weight before treatment and the amount of oil absorbed. The denser and heavier the block the smaller is the quantity of oil which it absorbs. That there is an important relation between the amount of oil absorbed per block and the penetration is of course obvious. Blocks which absorbed only 2 oz. of oil showed a far different penetration from those which absorbed 30 oz.

Conclusions from Accumulated Data

The conclusions drawn from all these experiments and the examinations of actual conditions in the street are that a thorough penetration of every block is impossible, but that a thorough penetration of the sapwood is absolutely essential for the preservation of the block. This can be easily obtained, provided sufficient quantities of oil are used and provided that the process of injection is properly conducted, irrespective of whether a straight creosote distillate oil or a solution of a reasonable amount of coal tar and creosote is used for preservative.

As to bleeding of newly laid wood-block pavements, both the straight creosote and the coal-tar solution stand on identically the same basis, provided the method of treatment is faulty. The criterion to be used in specifying the preservative ought to be only availability and cost. Both creosote oil and creosote oil mixed with coal tar are available and should be used. A reasonable addition of coal tar to creosote is held to be good practice, but a straight coal-tar product free from the admixture of other substances should be specified.

Municipal "Clean-Up" Campaigns

Various Methods and Plans as Employed by U.S. Cities — Organization — Programmes — Benefits Derived

The season of "clean-up" is about due. Systematic spring campaigns have of late become more and more popular and are receiving recognition in all parts of the world. Not only among towns and villages has the idea taken hold, but in some of our largest cities extensive work is undertaken each spring to beautify the streets and parks. Clean-up week is generally set for some time in April or early in May.

In this connection we are just in receipt of a report, "Municipal Clean-up" by the State Bureau of Municipal Information of the New York State Conference of mayors and other city officials. This report describes various methods and plans adopted by U. S. cities for municipal "clean-up" campaigns, their organization, literature used, programmes, etc. As indicating the wide-spread interest among our neighbors to the south in city cleanliness we print the following extracts from this report. Many Canadian towns would, we believe, do well to become more conversant with this subject.

In 1914 more than 2,500 cities and towns in the United States took an active interest in "clean-up week." As many cities use practically the same plans, the Bureau has attempted in this report to give only a resume of the various methods and plans adopted.

That clean-up week does not mean simply clearing the streets and vacant lots of rubbish and waste is shown by the extensive programmes carried out in most of the larger cities: Committees on fly extermination, mosquito extermination, vacant lots, school grounds, parks, back yards, front yards, fences, grass seed, flower seed, plants, railroad yards, manufacturing districts, business districts, alleys, public dumps, garbage, inspection of unsanitary conditions, fire prevention, etc., all enter into the clean-up element. Unsightly abandoned buildings, old houses and factories must be inspected and razed; combustible materials, wooden boxes, paper, furniture, etc., to be collected; chicken yards, stables, and railroad yards with their litter of scrap iron must all come in for their share of attention if the clean-up campaign is to be a success.

Propaganda

At the head of propaganda as well as publicity stand the insurance companies. They reach the individual citizen and endeavor to get his co-operation in the movement for more sanitary laws and conditions. Unlike the press they reach the foreigner, and the class of people who do not read the newspapers, or at best only the Sunday editions. One insurance company, which maintains an extensive welfare department, has ten millions of industrial policyholders in the United States and Canada. A collector,makes a weekly visit to every one of these homes, and at the same time distributes leaflets and circulars disseminating sound ideas in regard to public and private health.

It is not possible to over-rate the value of the press as a factor in the clean-up movement. Its work does not stop with the spreading of information both before and during the campaign, but in some instances has taken part in the activities. Its columns have been open to everything of a news nature that would materially assist—news stories, special articles, editorials, daily programmes, cartoons, advertisements, etc.

While the removal of rubbish is essentially a municipal affair, it would appear that it has been left, in most instances, to civic organizations, chambers of commerce, women's clubs and school clubs to stir up the agitation in regard to the collection of it.

Regular Programmes

Some cities have a regular programme for each day, such as paint day, fire prevention day, front yard, back yard, vacant lot, dandelion day, lawn-making, etc. Although clean-up programmes vary in length from two days to a month, two weeks is the usual length of time, and the following is the two weeks' programme:

Monday and Tuesday (fire prevention days): Induce all merchants, manufacturers and property owners to give special attention to cleaning up accumulations of rubbish out of attics, cellars, hallways, basements and barns. Make a special effort to get rid of all material that will cause fire.

Wednesday and Thursday (repair days): These days should be devoted to repairing porches, porch furniture, lawn swings, sidewalks, fences, screens and screen doors.

Friday and Saturday (paint-up days): These days are set apart for painting porches and porch furniture, doors, windows, screens, etc.

Second Week

Monday and Tuesday (front yard days): Give special attention to beautifying lots. Rake off all rubbish and clean sidewalks and gutters, plant flowers and make concerted effort to get rid of dandelions.

Wednesday and Thursday (back yard days): Clean yards, sow grass and flower seeds, plant trees, general clean-up.

Friday (vacant lot day): This is the day when people living in each neighborhood should help clean up vacant lots.

Saturday (inspection day): This ends the campaign and should be given over to public celebration, parades, inspection, etc. Usually a parade of school children headed by a band, motors carrying the mayor, superintendent of schools and other persons having charge of the campaign.

(The report here deals with the organization of committees by the mayor and the adoption of a plan of action or procedure to be followed by any particular city.)

Publicity

In the Philadelphia campaign the total space devoted to newspaper publicity amounted to 14,225 lines, or 88 full length columns of printed matter, or one column a day for eleven days in each of the daily papers. For the benefit of the foreign born the same information was printed in every foreign newspaper published in that city. Cartoonists depicted "clean-up week" as a family affair and showed it to be a real pleasure as well as a necessity. The editorial writers in a more serious vein urged the necessity of co-operation and pointed the way to communal benefits to follow.

Cincinnati reports that no other factor contributed to much to the success of the campaign as the newspaper. By giving daily reports of the progress of the work during clean-up week the newspapers create a rivalry among the various wards.

(The report publishes here a number of sample bulletins and posters as employed by different cities to excite public interest in their campaigns.)

Circular Letters

Over the signature of the director of the department of public works letters were sent to all advertisers, and every concern known to manufacture, advertise or sell any kind of an article used for cleaning purposes; business men's associations, women's clubs, civic organizations, theatre managers and real estate agents. The purpose of these letters was to request co-operation and secure local publicity. Neighborhood meetings, prize competitions for boys and girls, window displays and local newspaper advertising, were ideas suggested.

Circulars

Four million circulars printed in five languages, five municipal departments co-operating, in the municipal house cleaning in New York City. One official circular reads as follows:

"To every owner, occupant, representative of any building, apartment, room, yard or vacant lot: You are hereby notified to prepare and place within the stoop line for removal all rubbish and waste material, from lots, lofts, fire escapes, cellars, yards, alleys, air shafts, rooms and apartments. Old bedding, rugs, paper, furniture, broken-up boxes and barrels; glassware should be placed in barrels, boxes and bundles. It is against the law to throw materials in the streets. Neglect to comply with this notice will result in prosecution. The wagons will call at 8 A. M. Wednesday, May 20, 1914."

Placards

Placards bearing the silhouette figure of William Penn majestically swinging a broom over the city from his dizzy perch on top of the city hall appeared in every one of Philadelphia's 3,200 trolley cars. These were placed in the front and rear entrances in such a way that only the figure was visible from the outside. The appearance of the black and white sketch minus title or descriptive matter of any kind was perplexing to the passengers on entering the car and they would immediately look at the reverse side for an explanation. They got it in the form of an announcement for the annual "clean-up week," with just enough information and advice to be profitable, and most effective. This same figure was also distributed among the schools, libraries, railroad stations and other prominent places.

300,000 badges and blotters bearing sketches and jingles applicable to Clean-Up week were distributed among the schools.

School children dressed as little White Wings carried banners with the following inscription, in Toledo: Brighten up.

200,000 14 x 16-inch show cards, featuring the figure of William Penn, and below, the four words, "Soap, Water, Paint, Polish."

A large poster, 20 x 30 inches, along the same lines as the show card, was given space by the posting companies in more than 500 places throughout the city.

Street cars, elevated trains and platforms are utilized in an effort to attract the attention of citizens to their duty of cleaning their premises:

1. **Remember the time—April 25.**
2. **Help us clean up Philadelphia.**
3. **Soap—Water—Paint—Polish.**

Small leaflets, with applicable inscriptions, distributed by retail stores on packages.

Motion pictures and lantern slides showing the ravages of the fly, actual conditions existing from dirt, etc., have been a large factor in bringing the necessity for cleanliness before citizens and school children.

Rochester, one of the pioneer cities in the organization of the clean-up movement, arranged its publicity for 1914 thus:

1. The co-operation of the daily press.
2. The exhibition of slides in motion picture houses.
3. Sending letters to all lodges and orders asking for co-operation.
4. Printing by the local railways and light companies on the backs of their bills a fire warning. The same company also displayed similar information on their electric signs.
5. Use of the Boy Scouts to distribute dodgers to householders.
6. The co-operation of the clergy in preaching proper sermons.
7. Co-operation of the real estate exchange in cleaning up and keeping clean all buildings which the exchange have charge of.
8. Inducing manufacturing concerns to print suitable copy on pay envelopes.
9. Sending the fire warning in printed form to cigar stores.
10. Arranged that all caps for milk bottles during clean-up week be printed with a fire warning.
11. Secured the co-operation of all concerns selling fire-proof materials, such as cement, asbestos, fire-proof paint and roofing to advertise heavily during the clean-up week.

Commissioners of public works consented to allow posters put on the back of the rubbish wagons and the commissioner of public safety offered the use of the big fire engines for the same purpose.

Private Advertising

In all the large cities there is much private advertising during the clean-up campaigns: In Philadelphia the regular advertising pages of the newspapers for weeks ran individual advertisements of department stores, calling attention to the reduced prices of articles used for cleaning purposes. The more enterprising managers tried to outrival each other in the amount of space covered.

Special two-page sections contained nothing but advertisements on "clean-up week."

2,648 square inches of space were paid for by private advertisers, counting only single appearances. The majority of the advertisements, however, appeared at least three times, and in many cases daily for a week or longer.

The Metropolitan Insurance Company distributed 150,000 circulars to their policyholders through their agents, who in making their weekly premium calls went into the homes of thousands of foreigners and told them in their own tongue what "clean-up week" meant and why it was necessary for them to do what they were asked to do. This work is handled through the district agents in each city.

Miscellaneous Activities

It is impossible to include in a condensed report of this kind a full record of the help received from every source—by means of personal and telephone communications. No record is kept of such communications. Individuals and organizations all over the country have accomplished great results which have not come to the notice of the public through the newspapers. It is only possible to give here a partial list of the workers and organizations taking important part in these campaigns: The Press, Mothers' Clubs, Women's Clubs, Federation of Women's Clubs, Y. M. C. A., Advertising Clubs, Federation of Churches, Rotary Club, Civic Clubs, City Improvement Associations, Public Schools, Chambers of Commerce, Parochial Schools. All have done their utmost to make their cities more livable. Even the City Officials themselves have not been backward about taking part in the actual work. In the case of one Mayor it was said that anyone calling him on the telephone in the morning during clean-up week would be told that he was out shoveling.

1. The names of 600 owners of unimproved property which required cleaning up were obtained and to each one was sent a written request to remedy conditions. Approximately the entire number replied saying they intended to clean up, and they did so.

2. The city repainted its hydrants and the gas company repainted its street lamp posts.

3. The City Commissioners of Muskogee, Okla., planned to sow Bermuda grass on all vacant lots, and the committee appointed was to canvass all owners of vacant lots, urge them to sow grass and keep it closely cropped.

4. 4,500 tons or 6,136 cubic yards of miscellaneous waste were deposited at the dump during clean-up week in Washington. Not only city dump wagons, but contractors and private teamsters were pressed into service to haul it away.

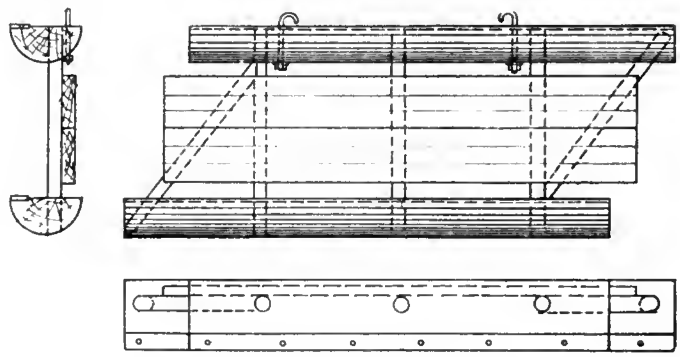
5. Brooklyn, divided into 40 districts, cleaned eight sections a day; local organizations distributed 150,000 pamphlets printed in three languages; the Housewives' League posted 22,000 clean store placards through the city; lectures were given by members of the City Departments which were illustrated by moving pictures and lantern slides.

6. An agitation has been started in Chicago to clean the roofs of the downtown district, as it is claimed that most of the dirt filling the air and streets is blown from the roofs which had not been cleaned since they were put up. The Street Cleaning Bureau is considering the complaint.

An Inexpensive Split Log Drag for Maintaining Country Roads

Any road construction is without permanent value unless a proper system of maintenance is established. An earth road, unless well cared for, is sure to rut and spread because of its soft surface in wet weather. This is especially true in the spring of the year, when the frost is leaving the ground. The surface of the road ruts easily, and unless repaired while still in a soft condition presents added difficulties later on. A systematic use of the split log drag at the proper season is one of the best and easiest methods of efficient maintenance.

The split log drag is easily and quickly made, and should be included in every township's road machinery. A light log from 5 to 7 ft. long, preferably of cedar, pine, or basswood, such as can easily be handled by a team, is split or sawn in halves. Place the halves parallel to one another, somewhat offset, edges down, with the flat face to the front, secure them firmly in this position with three 2-in. oak or elm crossbars, wedged into 2-in. holes bored in each half. These holes should be made somewhat above the centre line to allow the earth being dragged by the rear half to pass under the crossbars. Place two planks about the same length as the log on the crossbars; this enables the operator to stand on the planks and regulate the draft at either end, simply by moving to that end—for instance, if he desires to drag some material out of the ditch and place it in the centre of the road, by moving to the ditch end the draft is increased there, and the other end of the drag sufficiently elevated to allow the earth to pass under. To fill a low spot or a mud-hole, step quickly to the opposite end.



Details of a simple split log drag.

Road maintenance with a steel drag.

The length of the draw-chain also changes the line of draft; lengthening the chain is equivalent to putting a weight on the drag. If the drag is too heavy, shorten the chain; to remove more earth, lengthen the chain. Use some sort of catch clevis so that the drag may be drawn at any desired angle.

The drag may be either built with square ends or with the rear half offset, so that when the drag is drawn at an angle the ends of both halves are parallel with the axis of the road. There are arguments in favor of each design. If the road is soft and the latter type is used the front half takes all the draft, whereas if the halves were square and drawn at an angle each half would take a share of the material being moved.

The use of a strip of steel along the cutting edge not only gives the drag a better cutting edge, but also preserves the face. Fasten a strip of steel 2 x 4 ins. wide and ⅜ in. thick along the lower edge of the drag, and secure with stove bolts or heavy screw nails properly countersunk. Handles on the drag are often a decided advantage.

By dragging this implement up one side of the road and down the other the edges of the log plane off the ridges and rough places, drawing the material sideways and forward, filling in the ruts and hollows, and crowning it at the centre of the road. Use the drag when the road is very wet and slushy, or when very dry. There is an intermediate stage when the earth sticks and rolls up in lumps. If a clay road is dragged in a wet state a tough, rubber-like surface is produced. By means of this drag, together with a plow and harrow, much can be done to create a new road and keep old ones in good repair.

The steel drag is also very extensively used in some parts of the country, and while it may be more efficient for certain types of roads, it is often too heavy for a team of horses, and is not so cheap or easily handled as the split log drag.

Progress Report, Imperial Oil Building, Church Street, Toronto

Exceptionally rapid progress is being made on the new Imperial Oil building, located at the corner of Court and Church Streets, Toronto. Work on the new building commenced on December 8, 1915, when excavations were begun, the foundations being carried down 22 feet below street grade. Steel erection, including all riveting and painting was completed on

Imperial Oil Building, Church and Court Streets, Toronto.

March 31. The contract for the steel was placed on December 10, 1915, and steel was on the site ready for erection in two months' time. The arches were commenced on March 13, and are all in as far as the third floor at the present time. The exterior stone work started on March 25, and will be completed on or about May 10. Plumbers, electricians, and steam fitters are already on the job, and the work is well ahead of schedule.

The building occupies a frontage of 76 feet on Church Street, and extends back 115 feet on Court Street. It is of fireproof construction, steel framework with limestone exterior walls, and is seven storeys high, including the basement. The building was designed by Clinton & Russell, architects, and the contract was let to the Thompson-Starrett Company, of New York.

The exterior of the building will be Bedford limestone, in the Italian Renaissance style. The main entrance is on Court Street, which opens into a large hall leading to the three elevators and tower staircase. The ground floor will be given over for a banking room and stores, and will not at present be partitioned off. All the upper floors will be occupied by the Imperial Oil Company and its subsidiary companies. The rear of the building, adjacent to a 23-ft. driveway on the west side, will be taken up by storage room and display rooms for the products of the company. In the base-

Steel erection, March 21, 1916.

ment provision is made for a gymnasium, a court, shower baths, and locker rooms for the convenience of the occupants of the building.

The interior trim will be most elaborate, the building being finished in marble with marble mosaic floors and steel doors and trim. The board room of the Imperial Oil Company will be finished in panelled mahogany with ornamental plaster ceiling. Contractors are as follows: structural steel, Dominion Bridge Company; masonry and fireproofing, Witchall & Sons; steel casings and trim, A. B. Ormsby; plumbing and heating, W. J. McGuire, Limited; ornamental iron works and bronze, Architectural Bronze and Iron Works; electric wiring, L. K. Comstock Company; hardware, American Hardware Company; elevators, Otis-Fensom Elevator Company; plastering, A. Petrie; marble, Missisquoi Marble Company; vaults, J. & J. Taylor.

Modern Methods of Garbage Collection by Wagons and Motors

FOR collecting garbage in the larger cities of the United States many types of vehicles are used. Most cities are at present using a steel tank wagon, with either a bottom or a rear dump, depending upon the house treatment of garbage and whether the system is combined or separate. To be clean and sanitary any garbage vehicle should be metallic, fitted with covers, easily cleaned and disinfected, and as large as is convenient with the grades and conditions of the route traversed. Particular attention should be paid to the loading height, which should be at a convenient distance from the ground so that the collector can easily dump the garbage.

Type of Cover

The type of cover is also important. The most satisfactory type is the light, ribbed roof, arched over the top of the wagon at sufficient height to give a free space above the whole of the garbage, and to allow trap doors in the side of the wagon for emptying cans. The use of wooden or iron doors is impracticable, because they do not allow for expansion of the load. Wooden covers warp, do not fit tightly, need repairs often, and are in the way during collection. Iron covers are almost universally condemned on account of their weight and noisiness. Most cities use canvas covers.

Whatever the type of vehicle, the dumping arrangement should be quick and simple. The bottom dumping wagons give good results, but they cannot be used for town garbage unless wrapped. Many cities successfully use a rear dump wagon which is tilted by a hand-turning gear at the front.

Motor Truck vs. Wagon

The use of the motor truck for garbage collection has not always excited favorable comment in cities. There are several motor trucks in service in U. S. cities, but practically all of them are used for hauling from transfer stations over long distances to the place of disposal. The general concensus of opinion is that for distances less than a mile horse-drawn vehicles are best, while above that a motor truck is most economical, and that the electrically-driven motors are cheaper to operate than the gasolene-driven where the haul is short and many stops have to be made.

St. Louis recently made computations comparing the existing cost of hauling garbage from the longer haul distances with mule teams and by tractors. The distance was seven miles, and the saving in adopting the motor truck system was $3,500 a year. The Worcester Commission reports that for heavy long hauls under conditions where the truck can be kept moving the motor truck is the more economical. The city of Seattle hauls its garbage by motors from bunkers to place of final disposal and claim that they save from one-fifth to one-quarter of the time consumed by horse-drawn vehicles.

New York's Gas-Electric Trucks

The New York City Department of Street Cleaning recently made a test on motor trucks and proved their efficiency over the present system, giving a possible 18 per cent. for time lost in hauling, loading, and returning light, as against 43 per cent. under the existing system.

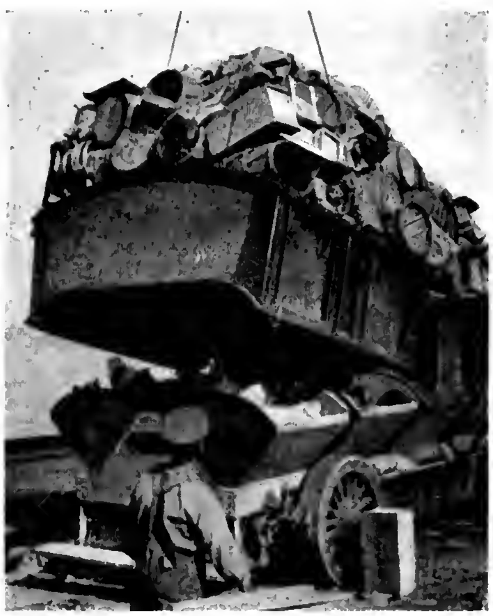
New York garbage collection—One of the 12 gas-electric trucks with trailer.

The twelve motor tractor-and-trailer units now employed in the model street-cleaning district of New York city, under the supervision of Commissioner Fetherston, are designed to do all the work in that district, including the collection of garbage, ashes and paper refuse in the day, the sweeping and flushing of the streets at night, and the cleaning off of snow in winter. Aside from the multifarious work which they are designed to do and the elimination of all horse-drawn vehicles in the area in which they work, the tractors are featured by the use of gas-electric drive and by the fact that they haul huge 20-ton detachable trailers.

Cheapness and Simplicity

The selection of the gas-electric type of drive on the tractors was made for cheapness and operating simplicity. While the electric tractor was highly desirable from the standpoint of ease of operation, the fact that each unit has to work 16 out of the 24 hours every day made its use impossible except by the employment of two sets of batteries, because of the mileage limitations imposed upon it by the storage battery equipment. On the other hand, the gasoline tractor with gear transmission, clutch and spark and throttle controls was impracticable because of the great number of stops in collection work, averaging from 60 to 100 per hour, and the subsequent slow acceleration between stops, the comparatively large consumption of gasoline during these periods, and the resulting necessity for drivers of a higher class.

The gas-electric type of drive, comprising a gasoline motor directly connected to an electric generator whose output is used in motors driving the rear wheels, combines the desirable qualities of both the purely gasoline and the purely electric tractor. The mileage



Unloading at docks by electric hoist.

limitation of the latter is overcome through the generation of the current by means of a gasoline motor instead of being taken from a storage battery. The simplicity of the electric is retained through the elimination of the gearset and the conventional controls of the gasoline tractor, while the comparatively large gasoline consumption of the latter, when the motor is run at normal speed during the many short stops, is eliminated by the use of a special device which automatically cuts the speed of the motor in half when there is no load on the generator.

Governor Device

The governor device consists of a solenoid of the plunger type, which is connected in the throttle lever of the gasoline motor by linkage. It is wired in multiple across the generator terminal through a contractor on the driver's controller shaft, which in turn is so arranged that a slight movement of the controller handle from neutral position in either direction will close the circuit, automatically speeding up the gasoline engine before the driving motors at the rear wheels begin to draw current. Conversely, throwing the controller to neutral automatically reduces the gasoline motor speed to half that when there is a load on the generator.

The solenoid device is locked to be tamper-proof. From the moment the gasoline motor is started at the beginning of the day's work, it is kept running without any attention on the part of the driver, its speed being regulated by the solenoid apparatus. All the driver has to do is to steer the vehicle and operate the controller, which gives five speeds forward and two reverse.

Trailers

Perhaps of equal importance with the design of the tractors is that of the trailers for the collection of garbage, ashes and paper refuse at the same time. The trailers make use of eight double-decked steel buckets, as shown in the accompanying illustration depicting the electric crane at the river-front dump lifting off the upper deck. The lower buckets are arranged in two longitudinal rows of four each, set into the trailer frame. On top of these are two other buckets with V-shaped bottoms and side doors. The latter are opened to permit the men to dump the cans of garbage or ashes into the eight buckets on the lower deck, the paper and other refuse collected being thrown directly into the upper buckets from the sidewalk.

In unloading at the disposal pier, the upper buckets are lifted off first, dumped into scows and then set down on the pier floor. Then each of the lower buckets is hoisted out and dumped in a similar manner. They are then loaded back onto the trailer in the reverse manner, when the unit is ready to return to its next point of collection.

Snow Removal

The sweeping and flushing of the streets and the plowing of snow in the winter is to be done by special trailers, but the city authorities have not yet appropriated the money for the purchase of these. The tractors were used to plow snow during the recent storms, however, by uncoupling the trailers and applying the conventional front-end plows.

Spring

With the fine weather of the last week contractors are putting their machinery in shape preparatory to the active commencement of construction work. The next five or six weeks will see more excavations completed than in the balance of the year. On the foundations depends very largely the life of a building. They should be broad and deep, going down sufficiently far to reach a good bearing surface, and in any case should be below the frost-line. Concrete for footings and foundations should receive special attention, should be well mixed, and carefully tamped in the trench to insure the maximum density. Buildings built on such foundations will never settle.

The Metals Coating Company of Canada are operating a demonstrating Laboratory at 90 St. James Street, Montreal, for the purpose of showing the highly efficient method by which metals of all kinds may be deposited on any surface. This is of particular interest to the shell manufacturers for building up short weight shells or covering iron shell clips with copper or zinc.

Road Construction and Maintenance

The Different Methods of Construction and Repair of Highway Pavements—The Necessity of a Good Organization

By W. H. Connell*

A GOOD organization is essential particularly in so far as maintenance is concerned, as it is practically impossible to continuously and systematically maintain pavements and roads in first class condition, in an economical manner, without a good working organization built up along the lines best adapted to cope with the conditions involved in this important branch of work coming under the jurisdiction of a highway department. By this it is not intended to give the impression that the maintenance organization should be separated from the construction, as separate organizations are apt to result in an overlapping of jurisdiction and a tendency to shift responsibility, and open up a field for unlimited excuses as to whether the construction or maintenance division is responsible for any unsatisfactory conditions that may arise relative to the pavements. Furthermore, it is obvious that the logical organization to maintain the pavements is the one that saw them laid and is familiar with every detail of the construction, as very often a knowledge of apparently trivial conditions in connection with the construction bears an important part in the future maintenance.

Knowledge of Details

It is the intimate knowledge of the details of both construction and maintenance, not considered separately but in their relation to one another, that is so desirable as a future guide in highway engineering; consequently the combination of the two organizations in one will accomplish far better results than they would working more or less independently of one another, each with a limited responsibility. Highway engineering may be considered a specialty, but further specializing in construction and maintenance is not logical as the two are dove-tailed and cannot be considered separately. Every engineer engaged in highway work appreciates the fact that there is no such thing as a permanent pavement for either city streets or country roads, consequently, in addition to the cost of construction, the maintenance repair charges during its life must be included in the final cost and is a most important factor in the selection of a pavement.

The main and most perplexing problem of a highway department, no matter whether the department be a State, Municipal, County or Town Department, is, or eventually will be, that of maintenance. If a large percentage of the roads or pavements are constructed, which is usually the case, then the maintenance predominates, and in fact it is only in localities where there are practically no roads or pavements, that the maintenance is subordinated to the construction.

The activities coming under the jurisdiction of the Municipal and State Highway Departments are not similar in every respect, but the principal functions do not differ sufficiently to affect the problem in the main.

A large Municipal Department embracing street cleaning, collection and disposal of ashes, garbage and rubbish, and snow removal, together with the general problems such as construction and maintenance of pavements, etc., embraces a greater variety of work than does a State Department, but principally of a nature that is essentially maintenance work. Likewise in a large State Department, with an active organization controlling a large area of improved highways, the maintenance problem is more involved and complicated than in a County or State Department with a less mileage of pavements or roads under its care, so that the perplexity of the problem increases not only with the number and variety of activities, but with the area of the territory and the mileage of roads and pavements coming under the jurisdiction of the department. It is, of course, a much simpler matter to cope with this problem where the work involved is such that it can be controlled from a central office, without delegating the responsibility to divisions and sub-divisions of the organization. This is especially true in maintenance work, as there is always a tendency among engineers to be lax in attention to details of an apparently simple and routine nature. They are apt to overlook the fact that it is no trick to construct a pavement, as in supervising this work they are simply following more or less standard and well defined principles, where, in maintenance work, there is no set specification to follow, the success depending upon attention, to a certain degree, to daily routine and principally to petty details that present themselves in the actual physical work, and in this there is an unlimited field for initiative. Personal experience in observations of the wear and peculiarities of the different types of pavements and road surfaces is invaluable as a guide in research work, as there is not a pavement today that cannot and should not be improved upon. The difficulty of impressing upon the supervising force the importance of this close personal attention to detail in connection with the care of the pavements is probably the most important single factor in the operation of a large highway department, and must be reckoned with and especially in these times when the public are becoming more and more exacting and virtually demanding that the roads and pavements be kept continuously in good repair. This should be obvious to all engineers in charge of highway organizations.

Classification of Maintenance

For convenience the different branches of maintenance work will be grouped under the following classifications:

1. Routine Maintenance.
2. General Maintenance.
3. Emergency Maintenance.

Routine maintenance includes such work as the regular street cleaning in municipalities, and the cleaning of country roads and gutters, and any other work of this character that is more or less routine and should be performed under a definite schedule. The streets in the thickly populated sections of the city should be cleaned every day; in less thickly populated sections, every other day; every third, and so on until we come to the country roads which should be cleaned once a week, once every two weeks, and some only

*Chief, Bureau of Highways and Street Cleaning, Philadelphia, before Third Canadian and International Good Roads Congress.

once a month, depending upon the amount and character of the traffic which largely governs the frequency with which the cleaning should be done. The amount and schedule of work and the force necessary to perform it can be determined upon in advance and carried on in a systematic manner under a regular organization, more or less military.

General Maintenance

General maintenance includes repairs to streets and roads, and involves different characters of work, each requiring special knowledge on the part of those engaged in the actual performance of the physical work for which special gangs have to be organized. Stone block, wood block, and brick repairs, for example, require skilled laborers who have made a specialty of this work and are employed under the title of pavers and rammers; while repairs to asphalt and bituminous pavements must be performed by men specially trained in this line of work, in addition to the necessary force engaged at the mixing plants. Macadam road repairs, the care of earth roads, and bituminous surface treatments, also require men specially trained, and while it is desirable to train the gangs for each particular branch of this work, such, for example, as bituminous macadam built by the penetration method, waterbound macadam, bituminous surface treatments, and the care of earth roads, the three classifications below are the three branches into which the organization is usually divided. Further sub-divisions can be handled by those directly in charge of the different classes of work coming under these divisions by training the laborers for the particular character of work to which they are assigned.

1. Block pavement repairs,
2. Bituminous pavement repairs (mixing method), sheet asphalt, bituminous concrete, etc.,
3. Country roads, macadam, gravel, etc., bituminous surface treatments, and earth road repairs.

This illustrates the difficulty of handling the work coming under the heading of general maintenance, which not only requires separate organizations made up of men specially trained in the different branches of the work, but the character and amount of the work itself is of such an indefinite quantity that it is very hard to control, and, furthermore, can only be performed in seasons of the year when weather conditions are suitable, all of which tends to make it difficult to maintain a good working organization, as is always the case when men are not regularly employed all year round.

The principal element leading to success in this work is the application of the theory that "a stitch in time saves nine." This not only applies to the patching of different characters of pavements, but to bituminous surface treatments, particularly when the treatment only consists of a paint-coat lightly covered with washed gravel or chips, which is only intended to last for a year or two. Very often when a treatment is required on a road and the performance of the work is postponed for a couple of weeks, the road will deteriorate and require resurfacing, so that it not only necessitates a more or less flexible organization for the actual performance of the work, but a very thorough study of the probable amount of material required, which should be purchased sufficiently in advance to avoid any delay in furnishing the material. This requires in addition to an efficient overhead organization composed of engineers well versed in the art of carrying on the work, a thoroughly systematized procedure suited to bring about the best results under the conditions to be met.

Emergency Maintenance

The third classification, or emergency maintenance, consists of such work as snow removal and taking care of extensive washouts, both of which require an emergency force, as work of this character must be performed at once and necessitates putting on an indefinite number of men, depending upon the volume of work, usually for only a short period of time. This makes it necessary for the organization to keep in touch with all available sources where men can be employed on short notice.

These are some of the reasons why the maintenance problem is the most difficult one in a highway department. Construction work, in the first place, is usually carried on under contract and all the cares and troubles relative to the labor situation are up to the contractor, the department requires the contractor to perform a specific piece of work under definite conditions and is only charged with the inspection, and the responsibility of seeing that it is performed in accordance with the requirements of the specifications. While, in the maintenance work the burden of the responsibility is up to the officials of the department not only in so far as the character of the work is concerned, but for the control of the organizations engaged in its performance.

The details of the different characters of repair work including the methods and materials used are, of course, very important, but nothing like as important as the length of time that elapses between the origination of the necessity for the repairs and the performance of the work. Repairs should be made as soon as the defects, no matter how slight, present themselves, and not weeks afterward. The secret of success in highway work is continuous and systematic maintenance. The up-keep is the real problem. The highways should be patrolled every week and oftener if necessary, and all defects reported and repairs made at once.

Patrol and Gang Methods

The general methods employed to maintain a system of highways in good condition are the patrol method and the gang method. The patrol method usually consists in having a man with a team and the repair equipment patrol and be responsible for making repairs to a certain, definite length of highway. The gang method consists in sufficient gangs being employed, equipped with all the materials to make repairs where ordered, the difference between the two methods being that in the first method the man who makes the repairs also patrols the highways, while the gang method is dependent upon the reporting of defects being made by special patrolmen, who may be inspectors, engineers, etc. There is some difference of opinion as to the better method, but it would seem that the reporting of the necessity for repairs by a special patrol inspector and the making of these repairs by a specially trained gang would be the better method. A detailed description of the methods of making repairs to the various types of roads and pavements would constitute quite a voluminous document. Consequently, it will only be possible to discuss the fundamental principles.

Dirt roads should be well crowned and drained. The shoulders should be kept clear, and the drainage ditches open. Road drags and road scrapers must also be used from time to time in order to keep dirt roads in good condition. An application of about a 20 Beaume gravity road oil once a year will not only lay the dust, but will help to compact the road surface under travel and form a sort of crust.

Gravel and waterbound macadam roads should be well crowned, well drained, and the shoulders and drainage ditches kept clear. The most effective method of maintaining gravel and macadam roads is through the use of bituminous surface treatments. The method and type of treatment used, however, will depend upon whether it is to be used for a gravel or macadam road and the character of gravel and stone used in the construction of the respective types of roads. On other classes of roads and pavements, such as bituminous pavements by the mixing and penetration methods, cement concrete, brick and stone block pavement, it is also important to keep the roads well drained, the shoulders clear, and the drains and ditches open. The methods of bituminous surface treatments used on the City of Philadelphia suburban and country macadam and dirt roads are as follows:

Suburban and Country Roads

The suburban and country streets and roads receive bituminous surface treatments of the character best suited to the respective roads, which are selected only after making a study of the type of construction, the traffic and social and local conditions in each instance. Generally speaking, two methods of treatment are used on the roads. For convenience they are divided, first, into bituminous surface treatments, intended to eliminate the dust nuisance and preserve the roads, and secondly, a cheaper method of bituminous surface treatment, used simply for the purpose of laying the dust on macadam, cinder and dirt roads, and not intended to preserve the road to any great extent.

The first method of treatment is used only on macadam roads that have been put in good condition, as it is a waste of money to put a high class bituminous surface treatment on a road that is full of ruts and pot holes and not properly shaped up.

The bituminous materials used in the City of Philadelphia consist of coal tar treatment, hot application, known as Tarvia A, coal tar treatment, cold application, known as Tarvia B, water gas tar treatment, hot application, known as Ugite No. 2, water gas tar treatment, cold application, known as Ugite No. 1, and asphalt cut-back treatments which consist of a mixture of 60 per cent. to 65 per cent. of 80 to 100 penetration asphalt, conforming to specifications adopted by the Association for Standardizing Paving Specifications at Pittsburgh in 1913, and 35 to 40 per cent. of 53 to 60 commercial naphtha. All of these materials are applied in quantities just sufficient to paint the road and to avoid possibilities of building up a pad. In other words, the purpose is simply to have a film coat of bituminous material on the surface of the road and to re-treat the road as often as is necessary to maintain the film coat, and in this way eliminate the pushing and rolling under traffic, which occurs with bituminous pads.

Method of Application

The method of applying these bituminous materials, when the road is in proper condition to receive such a treatment and the material to be used on the respective roads has been selected, is as follows: The roads are first lightly sprinkled with water and then swept with a horse-drawn broom. They are then swept with hand brooms until the surfaces of the stone are free from dust. This sweeping, however, should not be done in such a manner that the stone dust or binder will be removed from between the stones. The bituminous material is then applied with a pressure distributor at a certain rate per gallon which varies on different roads, depending upon their condition, and also whether it be a first, second or third treatment. The bituminous material is then allowed to remain on the road for about twelve hours or over night, after which fine washed gravel—

Passing ½ inch screen 100 per cent.
Passing No. 4 screen 50 to 60 per cent.
Passing No. 6 screen 20 to 30 per cent.
Passing No. 10 screen not over 10 per cent.

is spread over the road at the rate of 13 to 18 pounds to the square yard, depending upon the amount of bituminous material applied. In some cases clean trap rock chips passing a ⅝-inch ring and maintained on a ⅜-inch ring are used.

The theory of using fine washed gravel in place of stone chips is two-fold; first, to use a covering that will grind up and pulverize before the bituminous material has set up, and thus incorporate with it and build up a pad, such as is the case with the stone chips as they pulverize very quickly under any appreciable amount of traffic; second, it only contains 10 per cent. of the fine sand and the pebbles constituting the rest of the material are so hard that they do not grind up and pulverize for from three weeks to two months, depending upon the traffic. The process of pulverizing is so slow that the fine material is washed off the road after each rain, thus doing away with the necessity of sweeping the road to eliminate the dust, which is necessary where stone chips are used.

These treatments last for a year and have proved to be not only the most economical method of preserving roads of this character, but the cost is less than the cost of sprinkling with water provided the roads are sprinkled three times a day and this, by the way, is not sufficient to lay the dust, and, of course, it must also be understood that the sprinkling with water will not preserve the roads under automobile traffic.

Use of Asphaltic Oil

The second class of treatment generally used consists of asphaltic road oil from 18 degrees to 23 degrees Beaume gravity. This material is applied to all of the macadam roads that are not in fit condition for the first-class bituminous surface treatment and to all dirt roads, and is applied at the rate of 2/10 to ¼ gallon to the square yard. On some roads, depending upon the amount of traffic and whether or not the road is shaded, it is necessary to treat the road in May and treat it again in September. Such roads, however, are the exception. In most cases this method of treatment will last for one season. The roads as a rule are not swept before the application, nor is any covering put over this bituminous material, as it is applied in such small quantities that there is scarcely any necessity for covering. The purpose in putting on this small quantity is to insure its disappearing from the road before the winter sets in, in order to avoid the mushy condition that prevails when there is too much oil on the road in this season of the year.

The paint coat method of tar bituminous surface treatments on first-class macadam roads has been a success for seven or eight years in this country, and it has also been used to a very great extent for a number of years in England.

The asphalt cut-back paint coat treatments are somewhat new, and have been largely developed in Philadelphia during the last four years. The successful results in Philadelphia have led to its use in other localities in the east this year, notably by the Highway Department of the State of Pennsylvania, where a large mileage of roads have been treated using this method.

The asphalt cut-back bituminous surface treatment, was evolved through research work carried on with a view to finding some way to utilize an asphalt in the paint coat method of treatment which had been so successful with the tars. In order to do this, it was necessary to use a comparatively stiff asphalt so that it would set up quickly on the road. This necessitated cutting back an asphalt of about 100 per cent. penetration with from 35 per cent. to 40 per cent. of naphtha. The purpose of the naphtha is to make the material of such a consistency that it can be applied to the road when it is moderately warm. In other words, the naphtha simply acts as a carrying agent and after it has done its work, it evaporates and leaves the paint coat of asphalt on the road.

This material has proved to be a success under a four year test, re-treating, of course, every year or two, or as often as is necessary, as is also the case with the tars.

The methods of bituminous treatments described, however, are not applicable to all conditions. The roads treated must be built of comparatively hard stone, and the traffic conditions must be taken into consideration.

Range of Application

The method of bituminous surface treatment described for macadam roads built of hard stone and in good condition can also be used on gravel roads constructed of materials similar to what is commonly called Poughkeepsie gravel, which consists of large and small sized stones with fine gravel for a binder. Where the gravel is composed of any appreciable amount of clay, this method of treatment would not give very satisfactory results. The dust layer referred to, however, would benefit such roads to a considerable extent. In discussing these bituminous surface treatments it will be noted that great stress has been laid on a paint coat or film coat to be renewed each year or so, or as often as necessary. The object of this paint coat or film coat is to avoid the formation of a pad, but where the road is built of soft stone that would naturally be affected more by traffic than would the hard stone, this paint coat or film coat would not be satisfactory. In such cases, it would be necessary to use a larger amount of material and build up a ⅜ to ½-inch pad. It is practically impossible to give any general description for bituminous surface treatment work that will apply to all conditions, but there is no road that cannot be benefited by the application of bituminous surface treatments. It is, however, very important that all the details of the cleaning, etc., previously described should be given very careful attention, and the roads should be re-treated before they have gone into a condition of bad repair. After these re-treatments have been applied, that does not mean that they will not require any attention until the following year. Some roads, of course, will not require any attention until the time for the re-treatment, but a great many of the roads where the traffic is heavy will require patching all through the winter. The methods used in patching these bituminous surface treated roads in Philadelphia are as follows: Where the surface treatment has worn off in spots and there is likelihood of a pot-hole forming, the road is painted with tar used for cold treatments or asphalt cut-back, depending upon the character of material the road was originality treated with, and chips or gravel spread over the area of the surface, that has been painted. Where pot holes have formed, a mixture of ¾-inch stone and a heavy tar somewhat similar to Tarvia A or an asphalt of about 100 penetration is placed in the hole and tamped, and dry gravel or chips spread over the surface. This can be done by heating the tar or asphalt on the road and mixing it with the stone. But a more effective and better way to handle this kind of patching is to make up a mixture of the tar and stone and the asphalt and stone and place it at different locations along the line of the system of highways. By the use of a suitable mixture of asphalt or tar cut back with naphtha, it is possible to prepare large quantities of patching material which will not set up so that it cannot be re-handled and used for repair work during the winter, without the necessity of re-heating. This is known as the cold mixing method of patching bituminous macadam and bituminous surface treated roads. Such materials as Amiesite and Bicomac are also adopted for winter patching and have given very satisfactory results. The main point that should be, and has been, brought out in connection with repairs to roads and pavements of all descriptions is to make the repairs promptly when there is the slightest indication of the necessity for repairs, and thus avoid pot holes in the country roads and necessity for making extensive repairs to roads and pavements of all descriptions.

Now that you are building a large mileage of highways in Canada, it will not be long before your maintenance problem will predominate as it will be looming up larger each year, and you have a splendid opportunity to avail yourself of the experience gained by the failures in other localities where there has been a great deal of highway construction. In conclusion, it will not be an unfair statement to say that the failures in highway construction have been very much exaggerated. The trouble has been principally, however, the failure to maintain the roads and pavements after their having been constructed.

Trade Inquiries

Names and address may be had on application to the Department of Trade & Commerce, Ottawa.

260. **Reinforcing rods for concrete construction**—A New York firm of exporters desires to be placed in touch with Canadian manufacturers of reinforcing rods for concrete construction for shipment to Great Britain and Indian ports.

271. **Wire.**—In 22½, 23 and 24 gauge. Quotations for ten tons c. i. f. Glasgow.

273. **Boiler tubes.**—Either lap-welded or solid drawn. A Glasgow firm is prepared to receive quotations for the above.

277. **Scrap-iron.**—A Glasgow firm wishes to import heavy wrought-iron scrap, used iron or steel railway axles, shipyard steel scrap.

278. **Steel wire, nuts and bolts.**—A large Glasgow concern, at present importing from the United States, will be pleased to receive quotations for bright, mild steel wire, bright hexagon and square nuts, small bolts, etc. Would prefer to give Canada preference.

The Use of Vitrified Clay Segment Blocks in Sewer Construction

By J. M. Egan, Jr., C.E.*

At the present time, there are on the market two vitrified sewer blocks of different design, one being a single-ring block and the other a two-ring block. The single block has a ship-lap joint on the ends and a tongue and groove joint on the sides, while in the double block, the laps and joints are made in the construction of the sewer and the blocks are placed one on top of the other as in a two-ring brick sewer. The blocks are hollow longitudinally with web braces. They are made for sewers varying in size from 30 to 108 inches in diameter, and according to size, weigh from 40 up to 120 pounds, are 18 and 24 inches long, are from 9 to 15 inches wide, and are from 5 to 10 inches thick. Short lengths are also made for convenience in construction and for use on sharp curves. Special blocks are also made for connections and junctions and consequently this type of sewer is as flexible as any pipe, brick, or concrete sewer. The blocks are also made for use in egg-shaped sewers, in which case, an extra heavy base block is furnished.

Excavations

In constructing the sewer with the blocks, the method of excavating the trench does not vary from methods used in constructing sewers of other types. If the soil excavated is stiff enough to permit, the bottom of the trench should be shaped to conform to the outside of the sewer, thus forming a good foundation and eliminating excessive tamping. A template may be used to procure this shape as well as a means of guidance for laying the blocks. The first block is laid in the centre of the trench to line and grade and the blocks comprising the invert are laid to it. As the blocks of the invert are laid up, care in back-filling behind the blocks must be practised. The joints, both end and side, must be mortared about ¼ in. thick, and the blocks must be laid broken or staggered. The joints of the invert may be pointed up as they are laid. Careful tamping on each side of the spring line behind the blocks will give much added strength to the sewer and this tamping should continue to the second course above the spring line. Wooden forms are used for the arch and are usually placed a little bit higher than the required diameter in order to allow a little wider space for the key block. The blocks are then laid up on either side of the form, the key block finally inserted, the form immediately removed, and the arch will then settle into place and form the correct diameter. Back-filling can then be started at once. In laying these blocks, experienced bricklayers are not needed, as the ordinary pipe layer can soon pick up the art of laying the blocks. If wet and quick sandy conditions prevail in the trench and sheeting is necessary, it must be driven low and cut off and left in the trench below the spring line. In cases where steel sheeting would be used, very careful backfilling must be resorted to and as the sheeting is slowly pulled, water flushing must be carried on as it is very necessary that a good bearing be given the invert. In cases where the soil conditions in the trench bottom are very bad, planks may be laid under the first block or a cradle may be used for holding the first few blocks. However, there are no disadvantages in using the block in bad trench work not encountered in using other materials and it is claimed by some of the engineers that have used them in bad trench conditions, that they are to be preferred to any other type of material.

Cost

The cost of laying the blocks, of course, varies with the efficiency of the contractor and his organization, and with the varying labor conditions. It should not exceed 1 cent per inch in diameter of the sewer per lineal foot; this to include labor of laying, cost of mortar, and backfilling up to the spring line. The cost of the block is moderate and has the advantage over the large sewer pipe in that it takes a smaller freight rate, the breakage in transit is exceedingly small, and the cost of handling from cars to trench and in the trench is low as it is easily a one-man job. The cost of the block sewer complete is undoubtedly lower than the cost of either the brick or reinforced concrete sewer, and on account of its lower coefficient of friction, smaller sewers may be used with as good results as larger sizes of the other two materials with a consequent lowering of cost. There is only 7 per cent. of surface exposed to the jointing material in the block sewer as against 28 per cent. in the brick sewer, and the highly glazed impervious block is certainly superior to the ordinary sewer brick. Good speed in construction can be made and it is not necessary to have much trench open ahead of the block laying and, as mentioned before, backfilling can be done as soon as forms are lowered and the work cleaned up generally as it progresses. All of these points tend to lower the cost of this type of sewer with the advantage of giving a more efficient structure.

Good connections can be made between segment block sewers of different size as well as between segment block sewers and pipe lines. The segment block sewer can also be adjusted to fit sharp curves with very little loss of efficiency. Special blocks are made for the small connections with the pipe molded to the block and in the large sizes, four or six adjacent blocks are so molded in the manufacture to permit of the entrance of the large pipe and thus saves any cutting or chipping of the block on the construction work.

Adaptability of Segment Blocks

These blocks, while being particularly adapted for use in constructing storm and sanitary sewers, are also coming into use as outlet drains for large farm drainage projects instead of small open ditches. They can also be used for service tunnels as well as for highway culverts. Sewers of vitrified clay segment blocks have been constructed during the past few years in many large cities.

Both internal hydrostatic pressure and loading tests have been carried on in connection with this type of sewer and the results of these tests may be obtained from the manufacturers and testing laboratories, it being enough to state here that the strength of the blocks have proven ample and sufficient for the use for which they are made. Examinations of segment block sewers have been made after they have been in use for some time and the reports are that they are in good shape.

* Before Illinois Society of Engineers and Surveyors.

New Steel Bridge, Trenton

Substantial progress is being made on the new steel bridge over the Trent River at Trenton, Ont. This structure will replace an old covered-in wooden causeway with a light steel swing span, and is being built on the same site as the old bridge.

The substructure was commenced early in October, 1915, and, favored with mild weather, excellent progress was made, considering the obstacles to be overcome in placing the concrete piers in 16 to 18 ft. of water. Due to the fact that this bridge offers the

The Old Bridge at Trenton, Ont.

only means of communication between the eastern residential section and the western business section, the erection of the superstructure was held up, due to mild weather in January, until traffic could be maintained over the ice. Steel erection commenced on January 15, and was completed in forty days, including lost time.

The total length of the bridge between abutments is 560 ft., which includes three fixed spans 119 ft. centre to centre of pins, and one swing span 200 ft. centre to centre. There is a 24-ft. roadway between trusses, and two 5-ft. sidewalks. The floors on the fixed spans are concrete, while a double wood floor is placed on the swing span. The capacity of the bridge is given as twenty tons on two axles with 10-ft. centres. The swing span is operated either by hand or by electricity. The general contract for the entire structure was awarded to the Ontario Bridge Company, Limited. A more detailed description will be furnished on completion of the work.

Regent Theatre, Montreal

The Regent Theatre is the latest addition to the suburban moving picture houses in Montreal. It is situated on Park Avenue, in the north end of the city, and is by far the best equipped of any similar place of amusement in Montreal's outlying districts. The dimensions are—frontage 50 feet; depth 104 feet; and height 60 feet. The building is of reinforced concrete on the Kahn system; the roof is of 48 in. steel girders, while the span of 50 feet is without intermediate support, thus giving an uninterrupted view of the stage. The front portion of the theatre is faced with terra cotta, with just sufficient ornamental detail to emphasize the lines and proportions.

On entering the foyer, which is lined with marble and has a vaulted roof, there are two marble stairways on the right and left landing to the gallery which gives accommodation for about 500 people. Two wide stairways, with stone steps, provide entranceways to the seats. The front section of the gallery constitutes the family circle, fitted with easy chairs and separated by brass rails from the position. Between the main floor and the gallery is a mezzanine floor, above the entrance, on which is situated the board room and secretary's office. The auditorium has three aisles, and has accommodation for nearly 700 spectators. Under the overhang of the gallery is a vaulted dome, with concealed lighting in the ceiling. Two small flights of stairs give access to the boxes on either side at the stage end. The internal plaster details were designed by Mr. Hubert Tompkins of Montreal. The walls and ceilings are panelled and decorated in green, cerise, and old gold, with the glare of the lighting softened with green and amber leaded glass shades.

The main heating and ventilation equipment is situated in the basement, the system being designed by Mr. Fred Hoadley, of Montreal. The blast system of ventilating is used with an exhaust fan on the roof. Heat is provided by two low pressure steam boilers.

The building is made as fireproof as is practicable; there is very little lumber used, all the floors being either of concrete or terrazzo, and the stairways of marble or stone.

The architect was Mr. D. J. Crighton, of Montreal, who designed the theatre for the Independent Amusement Company.

The general contractors were the Nicholson Constructions, Limited, Montreal, and the sub-contractors: structural steel, Structural Steel Company, Montreal; roofing, Douglas Bros.; heating and ventilation, T. H. Higginson, Limited, Montreal; plumbing, John A. Gordon, Montreal; plastering, Geo. H. Knott and Company, Montreal; painting, Castle and Son, Montreal; ornamental iron work, Union Architectural Iron Works, Montreal; lighting fixtures and marble and tile work, the Robert Mitchell Company, Montreal; wiring, Philip Lahee and Company.

New Steel Bridge completed March 9th.

List of Manufacturers for Russia

The Russo-British Trade Exchange, Limited, 16 Regent Street, London, England, recently published in book form a list of English manufacturers, which has been distributed throughout Russia. This Exchange now announces that a similar book covering Canadian manufacturers is in course of preparation, and that information may be obtained from the McCann Advertising Agency, Toronto.

Paid Visit to Battle Front

Mr. E. A. Dunlop, M.L.A., of Pembroke, was the guest of the Canadian Society of Civil Engineers at a luncheon in the Russell house, after which he gave a very interesting address on his recent trip to the western battle front.

Mr. Dunlop while at the front was the guest of the Canadian Army Headquarters staff and thus had special opportunities of observing the organization and condition of the British Army, and more particularly the Canadian troops. The speaker graphically described his trip across the English channel in a torpedo boat destroyer and the organization the British navy has for protecting the channel. In describing the very efficient measures taken at the front to look after the welfare of the men in the trenches the speaker paid a very high tribute to the efficiency of the engineering service.

Work of Canadian C. E.

The work of Col. Mitchell, a member of the Canadian Society of Civil Engineers, and head of the Canadian Intelligence Department, was specially mentioned. Mr. Dunlop had the unique experience of entering front line trenches during daylight, and on Hill 63 he had an opportunity of seeing the German trenches as well as portions of the ground held by them. Mr. Dunlop contrasted the view taken by the people of France with the people of England and Canada. In France the old men and boys and the women are doing all the work keeping the roads repaired, etc. In Paris places of amusement are all closed, hotels, etc., are turned into hospitals and all privately owned automobiles are given over for war purposes.

The Need for Economy

In conclusion Mr. Dunlop particularly pointed out the absolute necessity for every one in this country to economize and give up all unnecessary luxuries in order, not only that the cost thereof may be saved, but that the labor used in the production of same may be utilized for the production of munitions and other defensive purposes.

The meeting was presided over by Mr. John Murphy, chairman of the branch. A very hearty vote of thanks was moved by Mr. C. R. Coutlee and seconded by Col. Anderson, after which Sir Mackenzie Bowell, the veteran Canadian statesman, made a short address in which he impressed upon the members the necessity of everyone contributing his share to the defence of the Empire.

The Town of Mount Forest, Ont., have just awarded a contract to the Turbine Equipment Company, Toronto, for one million Imperial gallons a day De Laval centrifugal pump, to be operated by a 50 h. p. Canadian Westinghouse motor. This equipment will be installed in the Mount Forest Waterworks pumping station.

Mr. Ernest McCullough, for many years a well known consulting engineer who has specialized largely on reinforced concrete design and construction, has recently become identified with the Portland Cement Association, 111 West Washington Street, Chicago. Mr. McCullough will be known officially in his new connection as Chief Engineer, Fireproof Construction Bureau.

Hudson Bay Railway Progress

The total expenditure on the Hudson Bay Railway and terminals to December 31st, 1915, was $15,465,304, according to a statement by Hon. Dr. Reid, made up as follows:—

General expenses, engineering, etc.		$ 721,974
Le Pas bridge and terminals		388,172
Le Pas Thicket Portage:		
On contract account	$3,229,994	
Rails, bridges, etc.	2,680,896	
		5,910,890
Thicket Portage to Split Lake Junction		1,661,291
Split Lake Junction to Port Nelson		1,815,869
Port Nelson terminus		4,977,208

The length of the line from Le Pas to Port Nelson is 424 miles, and the road has been graded to mile 378. Steel has been laid, including sidings, to mile 242, at which point erection is proceeding with the Manitou Rapids bridge over the Nelson River. This work, it is expected, will be completed in April when track work will be resumed. The track is surfaced to mile 225. The telegraph line keeps pace with the steel and has now been laid to mile 242.

The work is divided into three sections, and all three contracts are held by J. D. McArthur and Company. On section 1 $3.229,994 has been expended to date, on section No. 2 $1,602,300, and on section No. 3 $1,865,795, a total of $6,698,089. The total value of the work under contract is estimated at $9,629,605. During the coming summer the track will be carried forward to the second crossing of the Nelson River at Kettle Rapids at mile 332. Here there is a large bridge to construct and it is not expected that track work can proceed beyond this point until the spring of 1917.

Mr. D. H. McDougall

Mr. D. H. McDougall, the newly-appointed general manager of the Dominion Steel Corporation, has achieved his present position by dint of unremitting labor, by tactfulness and courtesy under the most trying circumstances, and by a most characteristic modesty.

Mr. McDougall was born in Glace Bay, Nova Scotia, and has been connected with the Dominion Coal Company and the Dominion Iron and Steel Company since a boy. The new general manager entered the survey staff of the Coal Company, afterwards joining the engineering staff of the Steel Company. He spent several years in the employ of the New York Central as an assistant engineer, coming back to the Steel Company to become field engineer. Mr. McDougall was then appointed as superintendent of mines and quarries in charge of the Steel Company's ore and limestone mines, and the general provision of raw materials. In the beginning of 1910 Mr. McDougall was appointed as assistant general manager of the Dominion Coal Company, Mr. M. J. Butler being at that time general manager of the Dominion Steel Corporation. On Mr. Butler's retirement from this position, Mr. McDougall was appointed general manager of the Coal Company, having throughout also retained his position as superintendent of mines and quarries of the Steel Company.

Mr. McDougall's position now involves direction of the coal mines at Glace Bay, and at Springhill, of the Steel Company's operations in Sydney, of the ore mines at Wabana, the limestone quarries at Marble Mountain and Georges River, C. B., at Port-au-Port, Newfoundland; of extensive lumbering operations and saw mills around Springhill and in New Brunswick; of two railways, namely the Sydney & Louisburg Railway and the Cumberland Railroad.

Mr. McDougall is president of the Mining Society of Nova Scotia, a vice-president of the Canadian Mining Institute, a member of the Institution of Mining Engineers (England), and a member of the Canadian Society of Civil Engineers.

Mr. A. W. Wheatley

Mr. A. W. Wheatley, president of the Lima Locomotive Corporation, Lima, Ohio, was born October 12, 1870, at Ashford, Kent County, England. He is a son of William Wheatley and of Agnes (Holly) Wheatley, both of English birth and ancestry. At the age of fifteen years he began as a rivet boy in the shops of the South Eastern Railroad, and in 1887, apprenticed himself as a machinist, attending night school. In 1892, he came to America and entered the employ of the Northern Pacific Railroad at Brainerd, Minn., as machinist; in 1893 was transferred to Staples, Minn., in the same position. In 1895 he was made foreman, occupying that position until 1900; transferred to Livingston, Mont., as general foreman in December, 1902, and later was made master mechanic of Yellowstone Division, headquarters at Glendive, Mont. In June, 1903, was appointed shop superintendent at Brainerd, Minn., and in April, 1904, was appointed general master mechanic of the entire system of the Northern Pacific Railway. In February, 1905, he accepted a position on Rock Island Railway as shop superintendent at Moline, Ill.; March 1906, accepted position as assistant superintendent of motive power of Union

Mr. A. W. Wheatley.

Pacific Railway with headquarters at Omaha. June, 1907, entered the employ of the American Locomotive Company at Schenectady as general inspector. December, 1907, was transferred to Montreal, Canada, as manager of American Locomotive Company's plant in that city. November, 1910, was transferred to Dunkirk, N. Y., in charge of that plant. June, 1911, accepted an offer from the Canadian Locomotive Company at Kingston, Ont., and was chosen as vice-president and general manager of that company, which position he resigned March 1st of this year to accept the presidency of the Lima Locomotive Corporation.

Pro Patria

Lieut. Hugh Heaton prior to the war was a student in the School of Practical Science in the 1916 class and he was serving his apprenticeship in the office of Mr. F. S. Baker. In May, 1914, he went to England to join Martin Baldwin, of the office of Sproatt & Rolph and the two spent the early summer on a bicycle trip throughout England, sketching and studying architecture. On the day war broke out they were both in London and immediately enlisted as privates in the King Edward Horse. Early in 1915 Heaton obtained his commission in the 8th Battalion King's Own Royal

Lieut. Hugh Heaton.

Lancaster Regiment and Martin Baldwin obtained his commission in the 9th Lancashire Regiment. Early in September Lieut. Heaton went over to France and since then he has been stationed near Ypres. News has just been received giving particulars of his wounding at the Ypres Salient. His Battalion, after a long stay in the international trench had been relieved and during their absence the relieving Battalion lost the trenches. On their return the King's Own proceeded to retake the trenches and it was during these operations that Lieut. Heaton was wounded. He was in command of a machine gun section. A memorandum has been received from a Tommy who saw him fall. He says that he was on the edge of a dyke and fell, badly wounded, into water, which was knee deep. He offered to help him, but Heaton refused to allow him to remain and sent him on fearing that the gun section was being cut off. He reported the incident and Lieut. Heaton was taken to the Relieving Station at Abeele. He was badly wounded by several bullets across the stomach, in the buttocks and in the left arm. For his conduct in these operations he has been awarded the Military Cross. For ten days he was reported by the War Office to be in a dangerous condition, but latest reports from the Red Cross Hospital at Le Touquet state that he is "wonderfully better and daily improving."

Mr. A. G. Hillberg, hydraulic engineer, New York City, is distributing reprints from the Engineering Record covering his papers on the design of intakes, scroll cases, and turbine draft tubes for single-runner turbines.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

My friends have been wondering what has become of me recently, and enquiring about my silence. I have not been asleep. I have been very much awake, watching with wide open eyes the course of events at Ottawa. I have seen the storm clouds gathering for an outbreak that is likely to end at an early date in a political cyclone. But what was the use of continually hammering away and telling about crooked letting of contracts for shells and shell boxes? I just got sick and tired of the job, but I could see the chickens poking their heads over the horizon on their way home to roost. So I settled down to wait until they began to flutter into the government coop and start something. A good many of the flock have reached home already and others are on the way.

"I told you so"—that is the way I feel about it all just now. When I began saying things about profiteering and crooked contracts generally in connection with supplying war materials, perhaps some readers thought I was going it pretty strong. I only wish I could have gone it a good deal stronger. However, this paper takes a good deal of pride in the fact that at a time when the public knew very little about the real state of affairs it was the first paper in Canada that had courage enough to come out clearly and draw public attention to what the Shell Committee was doing. From that day to this, every single day has been adding to the justification of our course.

* * *

Today we are told on the responsibility of a member of parliament that things appear to be even more rotten than we had thought. The latest charges are briefly as follows:—

That while Canadian firms were unable to get contracts for the production of time fuses, two United States companies, which were simply middlemen, received fuse orders amounting to $23,000,000 and were given cash advances amounting to $3,252,900 as an inducement to take the contracts;

That one of these companies was the American Ammunition Company, a mushroom company, with capital of $1,000, having no plant, which received orders for about $12,000,000 worth of fuses and an advance of $1,565,400 in cash;

That the other company was the National Arms and Fuse Company which got a contract for $11,250,000 worth of fuses and an advance of $1,687,500, being also a mushroom company, with capital of $3,000, and no plant;

That one E. B. Caldwell, president of the International Arms and Fuse Company; one B. F. Yoakum, New York, and one E. N. Bassick, Bridgeport, Conn., entered into a written agreement to divide $1,000,000 for getting contracts from the shell committee, before such contracts were in writing;

That Col. J. Wesley Allison was in an agreement with Yoakum and one Eugene Lignanti, an orchestra leader of Montreal, to secure contracts, and that Lignanti disposed of his one-tenth interest for $50,000;

And lastly, that General Hughes gave his formal approval of Allison's transactions.

Are not the indications pretty strong that the government we have in Canada to-day is about the rottenest we ever had, and that it is led by about the weakest leader imaginable? Such is the general opinion on the street to-day. While we in Canada have been straining every nerve and every muscle to do our share as a part of the Empire, to lead cleaner lives, and to help along the great task of defending the Empire against her foes, some of our trusted representatives in Parliament appear to have been bending all their energies and using every favorable opportunity for private profiteering.

* * *

There are many other things besides these war contract matters that the country wants to learn about. Many of us would like to know, for instance, about those Canadian officers now in England, some 1,500 I am told, who are doing nothing, so far as we can learn, but draw their pay just the same—living at the expense of the country.

* * *

Now that possibly the most strenuous period of the war is over, the Government seems to be willing to make something in the way of a bluff at protecting the Canadian people, by appearing to prohibit the export of nickel to our enemies. Just what this bluff is based upon we may not know, but it is said that the government's nickel policy is really controlled by two ministers, one at Ottawa and one at Toronto. I do not know about this, but would like someone to ask the government about it.

* * *

It must not be lost sight of that a strong Liberal vote—the silent vote—placed the Borden party in power.

This vote is not going to be satisfied with anything but the fullest investigation of the Shell Committee. Sir Robert Borden may think that by throwing dust in the eyes of the country he will save the party, but the "silent" vote waits round the corner.

Sir Sam Hughes as the "goat" will not satisfy. It is difficult to imagine Hughes so openly grafting (?) as claimed. The egotism of the Minister of Militia—appears an ass to the public—is equally distasteful to all of us, but there are many works and deeds to his credit.

* * *

It is folly for Borden and his cabinet to claim ignorance of what is going on. Did Hughes carry on these tremendous transactions unknown to the Cabinet? Did he draw those enormous sums of money unknown to Sir Thomas White, drop the Customs barrier unknown to Hon. J. D. Reid? Surely Hon. A. E. Kemp, under obligation to Sir Sam and the Shell Committee for many large orders, must have known.

Sam Hughes may come back and deny the charges. He has nerve enough to face any old charge, but will he stand being made the "goat." I don't believe he will and I don't believe the government dare make a goat of him.

No man should be in the Cabinet who is interested in contracts.

SEARCHLIGHT.

Personal

Mr. R. C. D. Tempest, resident engineer of the sewer section, Toronto, has resigned on account of ill health.

Mr. H. G. Girvin, chief chemist of the Steel Company of Canada, delivered an interesting address on Iron and Steel before a large and appreciative audience at the Technical School, Hamilton, on March 27.

Mr. Tom Moore, of Niagara Falls, Ont., organizer for the Carpenters' Union, says that members of this trade are enlisting in large numbers. He estimates that 12 per cent. of the organized carpenters have enlisted already. There are about 8,000 carpenters in the Union at present.

Obituary

Mr. John Flook, of Chatham, Ont., one of the best-known marine contractors in western Ontario, died suddenly on March 26. He had been a contractor on pier and breakwater construction for nearly half a century. He constructed the Tecumseh Park breakwater at Chatham and the first piers at Erieau, as well as many other works.

Mainly Constructional

East and West—From Coast to Coast

The Canadian Welding Works, Limited, Montreal, Que., have registered.

The Union Cement Company, Owen Sound, Ont., have commenced work for the season. They have a contract to supply 100,000 barrels of cement to the city of Toronto.

The work of rebuilding the Princess Theatre at Toronto, which was burned to the ground a year ago, is to be begun immediately. It is planned to open it on September 15.

Work on the Bloor Street Viaduct, Toronto, was stopped by the unusually heavy flood on the Don River last week. There was no loss around the viaduct, however, all the low-lying concrete having been finished.

According to figures compiled from tests made a year ago at the new waterworks plant at Sarnia, Ont., the city at the present time is losing close on $25,000 a year from water wastage.

Preparations are being made by the Canadian Stewart Company to proceed with the Harbor Improvement work at Toronto. The ice in the bay is expected to break up shortly, and construction work will proceed as soon as the tugs can get out.

It is stated that the Empire Hippodrome Company has taken out a charter for $1,000,000, and as soon as plans are perfected will erect a mammoth theatre at the corner of College and Teraulay Streets, having a seating capacity of from 4,000 to 5,000.

The Economy Foundry Company, of Portage la Prairie, Man., have received a contract to furnish all the ornamental iron work required in the new building for the T. Eaton Company at Winnipeg. The contract is worth about $25,000, and work on it is to begin immediately.

Some thirty-five members of the Calgary Branch of the Canadian Society of Civil Engineers attended the fourth dinner of the season, held on March 16, and after the repast enjoyed an address by Mr. G. N. Houston, of Denver, on the legislative control of civil engineering.

The Bloor Street Bridge over the Humber River, Toronto, has been swept away by the ice carried downstream by the swollen and swiftly-flowing current as the result of the spring thaws. The bridge had a span of 100 feet. It will probably be replaced by a new steel bridge.

At a recent meeting of the Toronto Bricklayers' Union, No. 2, of the International Union, the members decided each to give a day's pay for the purpose of keeping in good standing those of their number who are fighting the Empire's battles. Twenty-five per cent. of the members have enlisted

Trail, B. C., will be the scene of considerable activity in the building line this spring. Projected plans include a new fire hall, a school building costing about $15,000, and a building for the Trail Mercantile Company at a cost of from $8,000 to $10,000, in addition to a number of residences

The Laberge Lumber Company, Limited, of Sudbury, Ont., have secured from the Canadian Copper Company, of Copper Cliff, contracts for the building of twenty-one lodging houses and a store at Mileage 17 on the Algoma Eastern A start has been made with three gangs, and the work is being rushed to completion.

The town of Mount Forest, Ont., have just awarded a contract to the Turbine Equipment Company, Toronto, for one million Imperial gallons a day De Laval centrifugal pump, to be operated by a 50 h.p. Canadian Westinghouse motor. This equipment will be installed in the Mount Forest waterworks pumping station.

The Ottawa Board of Control have recommended to the City Council that the building by-law, limiting the height of buildings to 110 feet, be amended to make the maximum height 130 feet. There is some opposition to this, on the grounds that the Board of Control are violating their agreement with the Town Planning Commission.

The Builders' Exchange of Stratford and Perth County, Ont., which meets each week, reports the organization to be in a very flourishing condition. A membership of over thirty has been secured already, and this will reach the forty mark in time for the annual meeting, which will be held shortly. All branches of the building trade are represented.

A defective flue was the cause of a fire which partly destroyed the oldest building in Truro, N. S., "The Cottage," the residence of the late Sir Adams Archibald. The building was of quaint architecture, in the old English style, and was erected nearly one hundred years ago by the Rev. John Burnyeat, an Anglican missionary in Truro from 1820 to 1835.

An asphalt road is planned to be built between the city of Quebec and the concentration camp at Valcartier. The cost will be around $3,000 a mile, or a total of some $125,000, the larger part of which will be borne by the Provincial Roads Department. Work is to be started as soon as the snow melts, and alien enemies will be employed principally.

The Municipal Building of Walkerton, Ont., which was built in 1897, is showing many defects as the result of the sinking of the foundations. The council have condemned the hall for use, and the architect was asked to report on it. He recommends the building of two buttresses each on the west and north sides, which work will be carried out at a cost of $1,500.

It is reported in Calgary that the cement plant at Dauntless, south of Medicine Hat, Alta., which has remained in an unfinished state since the collapse of the building trades business some few years ago, is now to be completed. This plant was started by Mr. Leigh Hunt, of Kansas City, who is well known in Canadian circles, and who was employed by Sir Max Aitken interests.

St. John, N. B., is preparing to enter the housing business for the benefit of the city workmen. The first step was taken at a recent meeting of the common council, when a bill giving the city power to expropriate required lands, to erect houses suitable for homes of working men, and to issue bonds to cover the cost of purchase and erection, was forwarded to the Legislature.

Mr. Jackson Booth, of Ottawa, has a large building programme for this spring. He intends to raise his new Rideau Street Building to ten storeys, and to make a six-storey structure out of the building on Sparks Street occupied by the Standard Bank, removing the present two storeys over the bank and substituting five modern storeys. Mr. Booth also intends to build on vacant property at the corner of Bank and Slater Streets

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Barrie, Ont.
It is probable that the Town's pumping plant will have to be replaced in the near future with electrically driven equipment and a standpipe constructed at the head of Bayfield Street. Engineer, J. S. Lang.

Leamington, Ont.
The Town Council propose to lay watermains on a number of streets. Clerk, R. M. Selkirk.

Ottawa, Ont.
The City Council are considering the laying of asphalt and stone block pavement on Somerset Street, at an approximate cost of $11,440. Engineer, F. C. Askwith.

Quebec, Que.
The Provincial Roads Department will commence the construction of an asphalt road between the City and Valcartier Camp as soon as weather permits. Estimated cost, $3,000 per mile. Work by day labor.

Sault Ste. Marie, Ont.
The City Council are considering the construction of a waterworks system, estimated to cost $300,000. Clerk, R. G. Campbell.

St. Cesaire, Que.
The Municipality propose to spend $3,500 on macadam roads this season. Secretary, P. Dussault.

Toronto, Ont.
The Board of Control will receive tenders until April 11th on the construction of sewers on various streets. Plans at Room 8, City Hall.

Railroads, Bridges and Wharves

Dalhousie, N. B.
The Sydney Lumber Company propose to construct a wharf and piers this sum. Manager, F. McEvoy, Dalhousie.

Saskatoon, Sask.
The City Council have had plans prepared for asphalt paving on a new concrete bridge. Engineer, J. H. Archibald.

St. Boniface, Man.
It is understood that the Municipality of St. Boniface and the City of Winnipeg have agreed as to the apportionment of the cost of the proposed Provencher Avenue bridge, and that work may proceed shortly. Approximate cost, $264,000. Engineer, W. P. Blair.

York County, Ont.
The old wooden bridge over the Humber River at Bloor Street has been destroyed, and will be replaced by a steel bridge, estimated to cost $30,000. County Clerk, W. R. Phillips, 57 Adelaide Street E., Toronto.

CONTRACTS AWARDED

Arthur, Ont.
The Township Council have let a contract for the erection of a concrete arch truss bridge to J. Kilker, Harriston, Ont.

Ottawa, Ont.
The Ottawa Electric Railway Company have awarded the contract for extensions to their tracks on Rideau Street to the United States Steel Products Company, Bank of Ottawa Building, Montreal.

Port Hope, Ont.
In connection with the construction of a bridge on Peter Street for the Town Council, the contract for cement work has been awarded to Thomas Garnett & Sons, Port Hope, and the steel work to the Petrolia Bridge Company, Petrolia.

Public Buildings, Churches and Schools

Amabel Township, Ont.
The Trustees of School Section No. 7 will receive tenders until April 29th for remodelling the school. Work will include bricking of building, erection of porch and interior alterations. Secretary, H. W. Robinson, Hepworth.

Avon, Ont.
W. Murray, Dominion Savings Building, London, is preparing plans of a school for the School Board. Estimated cost, $6,000. Red pressed brick construction.

Calgary, Alta.
Central Methodist Church, which was recently destroyed by fire, will be rebuilt. Pastor, Rev. R. Fallis.

Dauphin, Man.
Plans of a Court House, estimated to cost $80,000, have been prepared for the Provincial Department of Public Works by J. H. Bossoms, Dauphin. Tenders will be called shortly. Brick and cut stone construction.

Hull, Que.
Charles Brodeur, 63 City Hall Street, is preparing plans of a convent for the Grey Nuns of the Cross, Ottawa, Ont. Pressed brick veneer construction with limestone trimmings. Estimated cost, $18,000. Tenders may be called in about one month.

Kinburn, Ont.
Tenders on the erection of a school will be received until April 6th by the Secretary to the Public School Board. Estimated cost, $10,000. Architect, J. P. MacLaren, 104 Sparks Street, Ottawa.

Middlesex, Ont.
A. E. Nutter, Dominion Bank Chambers, London, is preparing plans of a school, estimated to cost $4,000.

Orillia, Ont.
A by-law has been carried authorizing the raising of $35,000 for the erection of a Municipal Building. Architects, Burke, Horwood & White, Ryrie Building, Toronto.

Port Arthur, Ont.
E. J. Blaquier, 200 Arthur Street, is about to start work on the erection of a school at Jumbo Gardens.

Renfrew, Ont.
The by-law to authorize the erection of a Collegiate Institute has been defeated.

Sacre Coeur, Que.
Tenders are being received for repairs to the Roman Catholic Church. Curate, Rev. L. d'Anteuil.

Simcoe, Ont.
The Board of Education will select sites and have competitive plans prepared for two schools, estimated to cost $20,000 each. Secretary, F. E. Curtis.

Smith's Falls, Ont.
The Public School Board have purchased a site for a new school to replace that recently destroyed by fire. Estimated cost of building, $30,000. Secretary, C. T. McBride.

St. Cesaire, Que.
The Village School Board propose to build a model school, at an approximate cost of $8,000, and the Parish School Board are also considering the construction of two schools, estimated to cost $3,000. Secretary, P. Dusseault.

Toronto, Ont.
The Congregation of North Parkdale Methodist Church are raising funds for the erection of a Sunday School. Work is not likely to start this year. Pastor, Rev. J. S. Speer, 112 Sorauren Avenue.

Westboro, Ont.
Tenders on the erection of a school are being received by the Secretary to the School Board. Estimated cost, $25,000. Architects, Richards & Abra, Booth Building, Ottawa. Closing date, April 10th.

Winnipeg, Man.
The Provincial Department of Public Works will probably call for tenders about the end of the month for the completion of the Parliament Buildings. Architects, Simons & Paddington, Parliament Building. Estimated cost, $1,000,000.

CONTRACTS AWARDED

Hull, Que.
The contract for steel work required in the erection of the Church of the Holy Redeemer has been let to the Phoenix Bridge & Iron Works, Ltd., 83 Colborne Street, Montreal, the painting to R. Jacques, 50 Champlain Avenue, and the sheet metal and ornamental iron work to McFarlane & Douglas, 250 Slater Street, Ottawa.

London, Ont.
In connection with the construction of a Soldiers' Hospital for the Department

of Militia & Defence, the contract for plastering has been let to W. Scott & Son, 87 Bruce Street, the painting to I. Quick, 190 Colborne Street, and the plumbing to Noble & Rich, 237 Queen's Avenue.

Montreal, Que.
The contract for electrical work required in the erection of a school on Papineau Avenue for the Roman Catholic School Commissioners has been awarded to W. J. O'Leary & Company, 36 Recollet Street.

Mt. Dennis, Ont.
In connection with the erection of a school for Section No. 28, the contract for masonry has been let to Albert Webb, 13 Shirley Street, Toronto. Tenders on excavation are now being received by Mr. Webb.

Ottawa, Ont.
The general contract for alterations and additions to the City Hall has been awarded to A. E. Farley, La Banque Nationale Building.

St. Michel, Que.
The School Commissioners of St. Bernardin Ville, St. Michel, have awarded the contract for the erection of a school to Valin & Bail, 2 Lamoriciere Street, Montreal. Brick construction.

Business Buildings and Industrial Plants

Bridgewater, N.S.
Work will start shortly on the rebuilding of the Fairview Hotel for W. E. Awalt. Architects, Boehmer Bros., West Lahave. Frame construction. Approximate cost, $12,000.

Calgary, Alta.
The Alberta Farmers Co-operative Elevator Company Ltd., Lougheed Building, will receive tenders until April 15th for the supply of lumber required in the construction of fourteen elevators.

Crinan, Ont.
Jacob Zoller, Concession A, Crinan, will prepare plans for a large barn, estimates to cost $3,000.

Elmira, Ont.
Plans are now being prepared for rebuilding the sash and door factory of Bauman & Letson. A large quantity of machinery will be required. Particulars from Noah Beringer, Arthur Street.

Grand Prairie, Alta.
J. Thompson is about to erect a store and warehouse on Third Avenue South.

Halifax, N. S.
The Halifax Electric Tramway Company, Lower Water Street, are receiving tenders on the erection of a cold storage building in connection with their gas plant. Steel and brick construction. Engineer, H. R. Barrett, c/o the Company.

The Halifax Electric Tramway Company, Lower Water Street, are receiving tenders on the construction of the By-Product Building in connection with their gas plant.

Harrow, Ont.
The W. Clark Company, Ltd., 83 Amherst Street, Montreal, are considering the erection of a cannery. Estimated cost, $15,000.

Lethbridge, Alta.
P. Burns & Company, Edmonton, have purchased a site for an abattoir, and may start work shortly.

London, Ont.
A. E. Nutter, Dominion Bank Chambers, is preparing plans of a dining hall, estimated to cost $3,000.

Middleton, N.S.
The Dominion Atlantic Railway, Kentville, propose to build an engine house. General Manager, G. E. Graham, Kentville.

Montreal, Que.
J. Ortiz, 376 Fabre Street, is considering the erection of a store and two flats, estimated to cost $3,500. Brick construction.

Niagara Falls, Ont.
J. A. J. Upper Collins, 49 Benson Street, is preparing new plans of a garage to be built on Bridge Street for M. H. Buckley, 20 Ontario Avenue. Approximate cost, $6,000.

Orillia, Ont.
The Canada Builders, Ltd., will shortly commence the erection of planing mills. Brick construction.

Ottawa, Ont.
Sub-tenders on roofing, painting, heating, plumbing and electrical work required in the erection of a factory for Grant, Holden & Graham will be received until April 8th by the general contractors, Charles Hilbrook & Son, 425 Somerset Street.

Peterboro, Ont.
William Blackwell, Water Street, has almost completed plans of a storehouse and elevator for the Campbell Flour Mills Company, Ltd., George Street. Tenders will be called shortly. Estimated cost, $5,500.

Regina, Sask.
The Prairie Biscuit & Confectionery Company, Ltd., have had preliminary plans prepared for a factory, estimated to cost $60,000. Manager, H. W. Fox.

Sault Ste. Marie, Ont.
The City Council will shortly call for tenders on the erection of a power and pumping station on Gore Street, estimated to cost $7,500. Engineer, A. E. Pickering.

Plans are being prepared by B. McPhail, Tuson Building, Windsor, for a theatre to be built on Brock Street for S. W. Fawcett. Estimated cost, $20,000.

St. George, Ont.
The factory of R. Bell & Son Company, Ltd., will be rebuilt under supervision of the Company. Approximate cost, $5,000.

Steelton, Ont.
Tenders are now being received on the erection of a storage building for the Algoma Steel Corporation, Wilde Avenue, Sault Ste. Marie. Estimated cost, $11,000. Steel and frame construction.

Sutherland, Sask.
The erection of a factory is contemplated by the Trussed Wall & Concrete Company, Saskatoon. President, A. C. Gohn, Saskatoon.

Timmins, Ont.
Charles Pierce will receive tenders until April 15th for the erection of a theatre, estimated to cost $25,000.

Plans are being prepared for a station to be built by the T. & N. O. Railway, Toronto. Estimated cost, $12,000. Engineer, S. B. Clement, North Bay, Ont.

Toronto, Ont.
B. L. Slayer, 496 Bloor Street W., has commenced the erection of an addition to a store. Brick construction.

C. J. Read, Confederation Life Building, is preparing plans of an arena for the Old Orchard Club, 375 Dovercort Road. Steel and brick construction.

William Long, 406 Yonge Street, is considering the erection of an office and warehouse building.

Work is about to start on the erection of a factory building for William Neilson, Ltd., 277 Gladstone Avenue. Plans have been prepared by Sproatt & Rolph, 36 North Street. Approximate cost, $25,000.

The Comfort Soap Company, Eastern Avenue, have started work on the erection of an addition to their premises, estimated to cost $4,000. Reinforced concrete construction.

Trail, B. C.
The erection of a store is being considered by the Trail Mercantile Company. Estimated cost, $10,000. Concrete and brick construction.

Walkerville, Ont.
The erection of a factory is contemplated by the Canadian Brush Machinery Company, Ltd. Secretary, W. Elsey.

Wilkie, Sask.
The Saskatoon Pure Milk Company, Saskatoon, are building a creamery, estimated to cost $6,000.

CONTRACTS AWARDED

Brantford, Ont.
The general contract for the erection of a station for the Canadian Pacific Railway has been awarded to Schultz Brothers & Company, Ltd., 47 Albion Street. Approximate cost, $25,000.

The general contract for an addition to the premises of the Waddell Preserving Company, Ltd., 131 Clarence Street, has been awarded to Schultz Bros. & Company, Ltd., Albion Street.

The general, masonry, carpentry, steel work and roofing contracts for alterations to a building on Market Street for W. T. James, 52 Marlboro Street, have been awarded to the Purdy & Henderson Company, Ltd., 916 New Birks Building, Montreal. Approximate cost, $10,000.

Dartmouth, N.S.
The Department of Railways and Canals, Ottawa, have awarded the contract for the erection of buildings on the Dartmouth Branch Line to Denton & Condon, Digby, N. S.

Edmonton, Alta.
The Department of Indian Affairs, Ottawa, have awarded the contract for the erection of a number of houses to Pheasy & Batson, 203 Alexandra Block, Edmonton. Approximate cost, $16,285

Fraserville, Que.
The Freres Dionne have let the general contract for the conversion of premises into a restaurant to Francois Lachance. Approximate cost, $5,000

(Continued on page 47)

Tenders and For Sale Department

Tenders for
Concrete Pavement

Sealed tenders, addressed to A. H. Millar, City Clerk, will be received up to 5 o'clock p.m., **April 13, 1916**, for the construction of approximately 6,000 square yards of concrete pavement in the City of Berlin.

Plans and specifications can be seen at the office of the City Engineer.

The lowest or any tender will not necessarily be accepted.

HERBERT JOHNSTON,
City Engineer.

Berlin, March 21, 1916. 13-14

Tenders Wanted

Tenders for the erection of Cochrane (Ont.) Public School, according to plans and specifications of Angus and Angus, will be received up to 6 p.m., **April 25, 1916.** Plans and specifications can be seen at Secretary's office, Cochrane. Contractors to view present building and price to include wrecking and salvage. Marked cheques for five per cent. of tender, payable to School Board, to accompany each tender.

14-14 W. McD. DOUGLAS, Secretary.

TENDERS
for Second-Hand Rail and Switches

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, April 11th, 1916**, for the purchase from the city of the following:—

200 Long Tons 30-pound Rail;
20 only No. 5 x 30-pound Switches.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications may be obtained at the Works Department, Room 12, City Hall. Tenderers must comply strictly with conditions as to deposits, as set out in specifications.

T. L. CHURCH, Mayor,
14-14 Chairman, Board of Control.

City of London
Ontario, Canada

Sealed tenders, addressed to the "Chairman and Members of the Board of Control," will be received at the office of the City Clerk, up to 10 a.m., on **Friday, the 14th day of April, 1916**, for the supply of

(a) Motor-Driven Street Flusher.

(b) Road Oil Distributer.

Specifications and plans can be obtained at the City Engineer's office.

Tenders to be accompanied by a marked cheque or a cash deposit for 5 per cent. of amount of tender.

The lowest or any tender not necessarily accepted.

H. A. STEVENSON, Mayor.
H. A. BRAZIER, City Engineer. 14-14

Tenders for Paint

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, April 11th, 1916**, for the supply and delivery of Field Paint for Bloor Street Viaduct, No. 40.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenderers must comply strictly with conditions of City By-laws as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
14-14 Chairman, Board of Control.

Locomotive Crane Wanted

Wanted 15 or 20 ton Locomotive Crane, second hand, American make preferred. Must be in good condition. Address Box 376 Contract Record, Toronto, Ont. 12-14

Board of Education

Sealed tenders, addressed to the Secretary-Treasurer, Board of Education, will be received until

THURSDAY, APRIL 13th, 1916,

for the following trades:

FOR COMPLETION OF ADMINISTRATION BUILDING,
College Street.

Concrete Walks and Driveway.
Cabinet Work, Counters, Screen Partitions, Doors, etc.
Ornamental Iron Work, Spiral Stairs, Iron Railings, etc.
Leaded Lights.
Elevator.
Ash Hoist.
Vault Doors.
Hardware Trimmings.

also

For Furniture for Sundry Schools, including Teachers' Desks, Tables, and Chairs, Pupils' Desks, Kindergarten Furniture, Folding Chairs, and Lounges.

and

For Temperature Regulators for Dewson Street School.

Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto. Each tender must be accompanied with an accepted bank cheque for five per cent. of the amount of tender or its equivalent in cash, applying to said tender only. Sureties for all tenders exceeding four thousand dollars must be furnished by Surety Companies. Tenders must be in the hands of the Secretary-Treasurer, at his office in the City Hall, **not later than 4 o'clock** on the day named, after which no tender will be received. The lowest or any tender will not necessarily be accepted.

MILES VOKES, Chairman of Committee.
W. C. WILKINSON, Secretary-Treasurer.
14-14

For Sale

Concrete Plant and Gravel Yards for sale, at Wallaceburg, Ont. New, up-to-date, fully equipped with dry kilns and machinery; good location; four hundred feet along main street river front; block building 34 x 137 ft., one storey high, iron roof; good stock of sand and gravel. Reason for selling, death of owner. Apply Mrs. Anna Mae McDougall, Box 9, Wallaceburg, Ont. 14-15

Motor Squeegee Street Washer Removes Impacted Filth

A motor driven street washer that is said to clean a street as a rubber squeegee cleans a window, and which, it is claimed, will remove impacted dirt and filth in a manner impossible by ordinary methods has been put on the market by the Sterling Motor Truck Company, of West Allis, Milwaukee, Wis., under the name of the Sterling-Kindling motor squeegee street washer.

The machine consists of a special Sterling worm-driven chassis upon which is mounted a 1,000-gallon steel tank. Immediately in front of the front fenders are two flusher nozzles controlled by the driver by means of a lever. The nozzles by sprinkling the surface of the street prevent the agitation of dust, and also dampen the attached matter so that the squeegee roller can force it loose from the pavement, and wash the surface clean. Supplementing the function of the nozzles in loosening the attached matter, and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted behind the front nozzles, the purpose of which are to force aside the large refuse so that it will be suspended in the water, leaving the squeegee to wash up the tightly adhered material by frictional action. Mounted near the centre of the chassis frame, and underneath it, is a squeegee 19 inches in diameter, and 8 feet long. Each rubber spiral is easily detachable, and is mounted in a special kiln-dried wood holder of large wearing surface. The squeegee attachment is flexibly mounted and counterbalanced in such a way that when adjusted to a certain pressure, it is impossible for the roller to work loose, and the pressure against the surface of the street is uniform, the rubber strips being 6 inches deep and affording large wearing surface. A toggle joint linkage terminating in a lever in the driver's cab, enables him to easily and quickly place the squeegee attachment in and out of engagement with the street and, when returning from washing a section of street, to lift the roller out of contact with the pavement.

The tank is fitted with a water meter which indicates the amount of water flowing through it. It contains four valves near the front end for distributing water to the front and to the side nozzles near the squeegee roller.

Business Buildings and Industrial Plants

(Continued from page 45)

Halifax, N. S.
In connection with the construction of car barns for the Halifax Electric & Tramway Company, Lower Water Street, the contract for switches and frogs has been let to Loraine Steel Company, 21 State Street, New York, the steel work to the Nova Scotia Construction Company, Upper Water Street, and the roofing to the Canadian Asbestos Company, 44 Youville Square, Montreal.

Hamilton, Ont.
The Skedden Brush Company, 130 King Street N., have let the general, masonry, carpentry and steel work contracts for the erection of a factory to G. H. Gayland, 54 Lamoreaux Street. Estimated cost, $3,000.

Hull, Que.
The general contract for an addition to the premises of the Hull Iron & Steel Company, Ltd., Montcalm Street, has been awarded to H. P. Beck, 126 Sparks Street, Ottawa. Brick construction. Estimated cost, $4,500.

Leamington, Ont.
The Leamington, Mersea & Gosfield Agricultural Society have let the general contract for the erection of a hall at the Fair Grounds to Lewis Campbell, Leamington, at $5,430.

Maissoneuve, Que.
The general contract for the erection of a store for Dufault & Reed, 575 Notre Dame Street, has been awarded to A. Choquette, 170 Bourbonniere Avenue. Approximate cost, $10,000. Brick construction.

Montreal, Que.
The Montreal Locomotive Works Ltd., Longue Pointe, have awarded the general, masonry and carpentry contracts for an emergency hospital to A. F. Byers & Company, 340 University Street. Approximate cost, $7,000. Tenders are being received for the remaining trades.

The general contract for the erection of an abattoir for A. Leduc, 262 Green Avenue, Westmount, has been let to R. Laberge, 141 Convent Street.

Anglins Ltd., 65 Victoria Street, have been awarded the general contract for an addition to the central exchange of the Bell Telephone Company, 118 Notre Dame Street W. The contract for steel work has been let to the Dominion Bridge Company, Ltd., Lachine. Estimated cost, $52,000.

In connection with repairs to stores for the Fairman Estate, the general, masonry, carpentry, roofing, plastering and painting contracts have been let to McRobert & Gibeau, 10 Benoit Street, the heating and plumbing to Whyte & Delaney, 51 City Councillors Street, and the electrical work to Collyer & Brock, 131 St. Alexander Street.

The contract for steel work required in connection with the stores and residences being built for E. De Hivers has been let to the Dominion Bridge Company, Ltd., Lachine.

The contract for ornamental iron work required in the erection of a factory for Darling Bros., 120 Prince Street, has been let to Fred A. McKay, 14 St. George Street.

North Vancouver, B. C.
The contract for pile driving required in the construction of the plant of the Vancouver Creosoting Company has been let to Palmer Brothers & Henning, 929 Main Street, the contract for supply of boilers to Vancouver Engineering Works, 519 Sixth Street W., and for tanks and condensors to Ross & Howard Iron Works, Woodland.

St. Catharines, Ont.
The general and masonry contracts for an addition to the premises of the McKinnon Dash & Hardware Company, Ontario Street, has been let to Newman Bros., 71 St. Paul Street, and the steel work to the Hamilton Bridge Company, Bay Street N., Hamilton. Approximate cost, $3,500.

Steelton, Ont.
The following contracts have been let in connection with the addition now being built at the plant of the Algoma Steel Corporation, Wilde Avenue, Sault Ste. Marie:—masonry, D. J. Jannison & Sons, 635 Albert Street, Sault Ste. Marie; roofing, McPhail & Wright, Gouin Street, Sault Ste. Marie. Roofing by owners.

Toronto, Ont.
The general contract for the erection of a factory for L'Air Liquide Society, 16 Boler Street, has been let to J. D. Young & Son, 835 College Street, and for the concrete footings and floors to the Ramsay Construction Company, 39 Indian Road Crescent. Approximate cost, $3,550.

The Board of Control have awarded the general contract for the erection of a Fire Hall on Hendrick Street to A. J. Pemberthy, 272 Booth Avenue, at $23,523.

In connection with the erection of premises at Queen and Crawford Streets for the York Knitting Mills, Ltd., the carpentry contract has been let to R. G. Kirby, 539 Yonge Street.

The following contracts have been let for the erection of a store and bakery for the Standard Box Lunch, 563 King Street W.:—masonry, W. Montgomery, Lake Shore Road, Mimico; carpentry, S. R. Hughes, 79 Portland Street; steel work, Reid & Brown, Esplanade Street E.; glass, Consolidated Plate Glass Company, 241 Spadina Avenue.

Woodstock, Ont.
The contract for brick work required in the erection of a business block on Dundas Street for Arthur Patrick, Market Square, has been awarded to Charles Lewis. Greater part of work by day labor. Approximate cost, $15,000.

Residences

Aldborough Township, Ont.
Charles Dodie, Concession 8, is considering the erection of a residence to replace that recently destroyed by fire.

Anderson Township, Ont.
The erection of a residence is being considered by John Odette, Amherstburg, Ont. Estimated cost, $3,000.

Belmont, Ont.
W. Murray, Dominion Savings Building, is preparing plans of a bungalow for A. W. Beattie. Estimated cost, $5,000. Red pressed brick construction.

Brownsville, Ont.
A. Rutherford is considering the erection of a residence.

Camrose, Alta.
Antoni Pintowski is receiving tenders on the erection of a residence, estimated to most $3,000. Frame construction.

Essex, Ont.
John T. Rogers proposes to build two residences on Centre Street, at an approximate cost of $3,500.

Falmouth, N. S.
Stafford Akin proposes to build a residence, and will probably start work shortly.

The erection of a residence is being considered by Charles Manning, c/o the Hants County Fruit & Produce Company, Windsor, N. S.

Fingal, Ont.
The erection of a residence is being considered by Samuel Lethbridge. Estimated cost, $3,000.

Hagersville, Ont.
W. C. Vanhoon proposes to build a residence, and will probably call for tenders. Brick construction.

Leamington, Ont.
Walter White is about to prepare plans of a residence, estimated to cost $3,500.

Lindsay, Ont.
Plans are to be prepared for two residences for L. V. O'Connor and J. O'Reilly. Architect, M. H. McGeough, Simcoe Street. Red brick construction.

Listowel, Ont.
Henry Karges contemplates the erection of two residences, estimated to cost $4,000.

London, Ont.
Plans have been prepared for residences to be built on Windsor Avenue for Hyatt Bros., Egerton Street, South London. Estimated cost, $15,000. Red pressed brick construction.

Charles Dyson, 779 Dufferin Avenue, is preparing plans of a residence, estimated to cost $4,000. Red pressed brick construction.

G. C. Raymond, 2 Erie Avenue, proposes to build a residence on Windsor Avenue. Approximate cost, $4,000.

London, Ont.
P. Lizmore, 211 Ridout Street, has commenced the erection of three residences on Duchess Avenue, estimated to cost $11,000. Red pressed brick construction.

London Township, Ont.
The erection of a residence is being considered by Thomas Guest, R. R. No. 2, London. Estimated cost, $3,500.

Mt. Elgin, Ont.
Plans of a residence are being prepared by Walter Ellery, R. R. No. 2, Mt. Elgin. Estimated cost, $3,500. Red pressed brick construction.

F. Harris, R. R. No. 2, Mt. Elgin, intends to erect a residence, estimated to cost $3,200.

Niagara-on-the-Lake, Ont.
Charles Bufton proposes to build a residence on Gate Street.

Outremont, Que.
A. Gamelino C. P. R. Hotel, has prepared plans of four cottages to be built by A. Claude, 196 De l'Epee Avenue. Approximate cost, $21,000. Brick construction.

Peterborough, Ont.
James Lewis, c|o Oriental Barber Shop, is receiving tenders on the erection of a residence on Stewart Street. Architect, William Blackwell, 372½ Water Street. Estimated cost, $5,000. Brick construction.

Port Elgin, Ont.
D. J. Izzard will probably erect a residence on Gustavus Street this season.
Charlie Gilbert proposes to build a bungalow and may start work shortly.

Port Hope, Ont.
Ellis & Ellis, Manning Chambers, Toronto, have prepared plans for a residence to be built on King Street for J. A. Hume. Estimated cost, $10,000. Artificial stone, steel and pressed brick construction.

Quebec, Que.
E. Larcher, 1245 St. Valier Street, has commenced the erection of a residence, estimated to cost $3,000. Brick and frame construction.

Work has been started on the erection of a residence on Hermine Street for Leon Dolbec, 152 Lockwell Street. Brick and frame construction. Approximate cost $3,000.

St. Catharines, Ont.
Plans of a residence to be built on Glen Ridge for A. H. Wallace, 97 St. Paul Street, are being prepared by A. E. Nicholson, 46 Queen Street. Approximate cost, $10,000. Hollow tile and stucco construction.

St. Marys, Ont.
Stafford & Henderson propose to build a residence on James Street, at an approximate cost of $3,500. Red pressed brick construction.

F. H. Smith intends to prepare plans of a residence to be built on James Street at an approximate cost of $4,000. Red pressed brick construction.

Thorndale, Ont.
Plans of a residence are being prepared by James H. Murphy, R. R. No. 2, Thorndale. Red pressed brick construction. Estimated cost, $4,000.

Toronto, Ont.
Tenders have been received for the erection of a residence for P. Morgan, 68 Bellefair Avenue, and contracts will be let shortly. Approximate cost, $9,000. Architect, A. J. Stringer, 53 McLean Avenue. Brick construction.

W. H. Avison, 573 Indian Road, is about to start work on the erection of a residence, estimated to cost $3,500. Smaller trades will be sub-let. Brick construction.

Plans have been completed for a residence to be erected on Glendale Street by J. Carroll, 223 Garden Avenue. Brick construction. Estimated cost, $3,000.

Plans are being prepared for two pairs of residences to be built on Keene Street, York Township, by J. Gifford, 190 Pape Avenue. Brick construction. Approximate cost, $8,000.

P. McMaster, 97 Woodycrest Avenue, intends to build a pair of residences on King Edward Avenue, at an approximate cost of $4,500. Brick and roughcast construction.

CONTRACTS AWARDED

London, Ont.
The general contract for the erection of a residence for I. B. Whale, 21 Elmwood Avenue, has been awarded to A. Dickinson, 4 Ingleside Place. Red pressed brick construction. Approximate cost, $3,000.

Montreal, Que.
The contract for plastering in connection with the flats being built by F. Leduc, 314 Melrose Avenue, has been let to J. A. Lacombe, 914 Papineau Avenue.

The general contract for alterations to a residence for M. Larue, 402 Lagauchetiere Street, has been let to Lacroix & Vezeau, 491 DeMontigny Street.

In connection with the residences which are being built by D. Peloquin, 447 Old Orchard Avenue, the contract for roofing, heating, plumbing and electrical work has been let to Ducharme, Blais & Company, 1995 St. James Street.

The contract for roofing, heating, plumbing and electrical work required in connection with the flats now being built by C. E. Pepin, 129 Marlowe Street, has been let to Ducharme, Blais & Company, 1995 St. James Street, and the plastering to Donat Perron, 524 Moreau Street.

Niagara Falls South, Ont.
Work has been started by J. F. Langley, McRae Street, Niagara Falls, on the erection of a residence for F. MacIntosh. Approximate cost, $3,000.

Peterboro, Ont.
The general contract for the erection of a residence for Dyson Worth, 476 Cedar Street, has been awarded to Ephgrave & Barrett, 492 Cedar Street, the masonry to W. J. Mein, 427 Mark Street, and the plumbing and heating to George Brenton, Hunter and Queen Streets. Approximate cost, $5,000.

Quebec, Que.
The general contract for the erection of a residence for F. Gingras, 108 Artillerie Street, has been awarded to Odina Nolin, 113 Des Stigmates Street. Brick construction. Approximate cost, $5,000.

The following contracts have been let in connection with the residence being built by J. E. Tremblay, 72 Second Avenue, Limoilou:—carpentry, A. Drouin, Canardiere Road; roofing, plumbing and electrical work, U. Gauvin, Limoilou; plastering, J. Villeneuve & Son, 295 Prince Edward Street.

The general contract for the erection of a residence for Pierre Bertrand, 134 Napoleon Street, has been awarded to J. Noel, 1237 St. Valier Street. Brick and frame construction. Approximate cost, $3,000.

St. Catharines, Ont.
The general contract for the erection of four cottages for W. H. McCordick, 199 St. Paul Street, has been awarded to G. M. Elson, 98 Henry Street. Cement block construction. Approximate cost, $4,000.

Three Rivers, Que.
The general and masonry contracts for the erection of a residence for Jules Briere have been let to Anselme Dulee, Bellefeuille Street. Wood and brick construction. Approximate cost, $5,000.

Toronto, Ont.
Work has been started on an addition to the residence at 110 St. George Street for Mrs. R. T. Gooderham, 331 Sherbourne Street. The contract for masonry has been let to T. Cannon & Son, 75 Brock Avenue. Approximate cost, $11,000.

Work will start shortly on the erection of a pair of residences for W. Hughes, 59 Amroth Avenue. The general contract has been let to A. Binns, 50 Amroth Avenue. Smaller trades will be sub-let. Approximate cost, $4,000.

William Vokes, 228 Rusholme Road, has been awarded the general contract for the erection of a residence for J. H. Bone, 18 Toronto Street. Estimated cost, $5,000. Smaller trades will be sub-let.

The contract for masonry in connection with the residence and garage being built by A. E. Whatmough, 491 Keele Street, has been let ta Purton & Chennells, 158 Ellsworth Street. Other trades will be let by owner. Estimated cost, $3,500.

The contract for masonry required in connection with the erection of a residence and garage for C. James, Nanton Court Apartments, has been awarded to Booth Bros., 51 Kingswood Road. Tenders have been received for carpentry, and other trades will be let later. Estimated cost, $5,000.

Westboro, Ont.
W. C. Leech, 140 Spadina Avenue, Toronto, is building a residence, and has let the contract for electrical work to Charles Presby, 138 Irving Avenue, Ottawa. Brick veneer construction. Approximate cost, $3,000.

Westmount, Que.
The contract for most of the work required in interior alterations to a residence for A. A. Larocque, Linton Apartments, Sherbrooke Street W., has been let to C. Thibault, 553 Henri Julien Avenue, and the electrical work to F. Wilson. Estimated cost, $5,000.

Windsor, N. S.
The general contract for the erection of a residence on King Street for D. N. Slack has been awarded to R. H. Canavan. Frame construction. Approximate cost, $5,000.

R. H. Canavan has been awarded contracts for the erection of a residence on King Street for D. N. Slack and another on Park Street for Mrs. A. Forsyth. Frame and brick construction. Estimated cost, $5,000 each.

Wolfville, N.S.
Charles E. Wright, Wolfville, is about to start work on the erection of a residence for Olto Foshary. Estimated cost, $3,000. Concrete and stucco construction.

Power Plants, Electricity and Telephones

Appin, Ont.
The Village Council are considering the installation of an electric lighting system. Clerk, Dugald McIntyre.

Boston Creek, Ont.
The R. A. P. Syndicate, Boston Creek, propose to instal a 100-h.p. motor when the power line from Cobalt is built. Manager, John Papassimakes.

Cobalt, Ont.
The Northern Ontario Power Company, Cobalt, will shortly call for tenders on the construction of a transmission line to Kirkland Lake, a distance of sixty miles. Transformers and other equipment will be required.

Easthope Township, Ont.
The installation of a hydro system is

(Continued on page 50

Power Plants, Electricity and Telephones

(Continued from page 48)

being considered by the Township Council. Clerk, J. D. Fisher, Stratford.

Galt, Ont.
A by-law to authorize the installation of an electric fire signal system at an approximate cost of $16,000 will be submitted on April 28th. Town Clerk, Joseph McCartney.

Glencoe, Ont.
The Town Council propose to obtain estimates on the installation of a hydro system. Clerk, George Wilson.

Kirkland Lake, Ont.
Tenders on the supply and installation of motors for running a day mill and compressor will be called shortly by the Buffalo Mines, Cobalt.

Vernon, B. C.
Fire Chief Moffat has recommended the installation of a fire alarm system, estimated to cost $6,000. City Clerk D. J. Tate.

Winnipeg, Man.
The Board of Control will receive tenders until 10 a.m., April 17th, for the supply of material for overhead and indoor construction, watt hour meters and three transformers for the City Light & Power Department.

CONTRACTS AWARDED

Emerson, Man.
The Town Council have awarded the contract for the installation of an electric lighting system to the Dodge County Power Company, Hayfield, Minn.

Fires

Aylmer, Ont.
Nairn Block, owned by J. J. Nairn, damaged.

Berlin, Ont.
Pavillion in Victoria Park, owned by the City Council. Loss, $6,000.

Blenheim, Ont.
Garage owned by the Springsteen Company. Loss, $16,000.

Bryson, Que.
Mining mill and store owned by the Calumet Zinc and Metals Company, totally destroyed. Will rebuild.

Dauphin, Man.
Town Hall. Loss, about $5,000.

Elmira, Ont.
Sash and door factory owned by Bauman & Letson. Loss, $10,000.

Fassett, Que.
Factory of the Standard Chemical Iron & Lumber Company. Loss, $75,000. Will rebuild.

Granby, Que.
Residence of J. Brodeur destroyed.

Halifax, N. S.
Factory owned by James Roue, 121 Lower Water Street. Loss, about $14,000.

McKay's Corner, N. S.
Residence of Hugh McPhee totally destroyed.

Montreal, Que.
Three flats belonging to Mrs. Lepailleur, 1338 St. Denis Street. Loss, [illegible]000.

Ottawa, Ont.
Residence of Edward Pieche, Rockliffe Annex. Loss, $3,000.

Port Burwell, Ont.
Livery barn owned by George Riddell. Loss, $5,000. Rebuilding is contemplated.

A. R. Wright & Sons' warehouses. Loss, about $6,000.

South Bay, N. B.
Residence of John E. Moore. Loss, about $3,000.

St. Clothilde, Que.
Sawmill owned by Omer Bergeron. Loss, $7,000. Will rebuild.

Toronto, Ont.
Office and warehouse at 77 Bay Street tenanted by Brown & Stainton, Stationers, Joss Ltd., Furriers, and L. Babayan, Rug Merchant. Loss, about $60,000.

Trenton, Ont.
King George Hotel, owned by H. Cook. Loss, $25,000.

Welland, Ont.
Residence of Fred Guido. Loss, $3,500. May rebuild.

Whonnock, B.C.
Store owned by J. H. Methot completely destroyed.

Miscellaneous

Arnprior, Ont.
Maurice Sullivan, Contractor, Harriett Street, desires to receive prices and other information with regard to all kinds of building material.

Blenheim, Ont.
The Union Natural Gas Company propose to lay an 8-inch main on Talbot and South Hall Streets. Manager, T. E. Bassett, Charles Street.

Galt, Ont.
The Town Council will submit a by-law on April 28th to authorize the purchase of a motor fire engine, at an approximate cost of $12,000. Clerk, Joseph McCartney.

Halifax, N. S.
The Halifax Electric Tramway Company, Lower Water Street, are receiving tenders on elevating and conveying machinery for their new gas plant. Engineer, H. R. Barrett, c/o the Company.

Montreal, Que.
The Miner Lumber Company, Ltd., Coristine Building, are in the market for wood-working lathes.

Ottawa, Ont.
The Works Department will purchase several tank cars of tarvia for use this spring. Engineer, F. C. Askwith.

CONTRACTS AWARDED

Ottawa, Ont.
The City Council have awarded the contract for the supply of asphalt to the Barber Asphalt Company, Philadelphia, and for brick to the Ottawa Brick Company, Castle Building.

Late News Items

Dartmouth, N.S.
Tenders on the completion of a foundry for the Williston Steel Foundry Company are being received by the Engineer, C. Hedley Williston, 504 - Robie Street, Halifax. Approximate cost, $16,000.

Dover Township, Ont.
Tenders will be received until April 11th for the erection of a church for the Presbyterian Congregation. Architect, S. G. Kinsey, 14 Fifth Street, Chatham.

Kinburn, Ont.
Tenders on the erection of a school will be received until April 12th by F. Stackhouse, Secretary to the Public School Board. Estimated cost, $10,000. Architect, J. P. MacLaren, 104 Sparks Street, Ottawa.

London, Ont.
The Board of Control have awarded the contract for laying 52,000 square yards of asphalt pavement to the Standard Paving Company, Central Chambers, Ottawa, at $104,000.

Nassagaweya Township, Ont.
S. B. Coon & Son, Ryrie Building, Toronto, will receive tenders until April 8th for the erection of a school, estimated to cost $5,000.

Niagara Falls, Ont.
The general contract for the erection of an addition to the Bank of Hamilton, Queen Street and Erie Avenue, has been let to John Blair, Morrison Street, the painting to J. Smith & Sons, 168 Ontario Avenue, and the plumbing and electrical work to the Niagara Electric Company, Niagara Falls South. Approximate cost, $15,000.

Quebec, Que.
Tenders will be received until 4 p.m., April 11th, by the Secretary to the City Council for the supply of between 2,000 and 4,000 feet of fire hose, battery zincs, sulphate of copper and waterproof wire. Specifications at office of the Fire Department.

Sault Ste. Marie, Ont.
Tenders on the erection of a power and pumping station will be received until 5 p.m., April 10th, by the City Clerk. Estimated cost, $15,000. Engineer, A. E. Pickering.

Toronto, Ont.
The general contract for the erection of a machine shop for Whitfield & Company, 33 Sherbourne Street, has been awarded to Davidson & Company, 188 Duke Street, and work has been started. Approximate cost, $12,000.

A. R. Clarke & Company, 633 Eastern Avenue, are receiving tenders on the erection of a workshop, estimated to cost $30,000. Concrete, steel and brick construction.

The Board of Education will receive tenders until April 11th on the supply of four motors for the Technical School, Lippincott Street. Plans and specifications at Principal's Office.

Tenders on the supply of field paint for the Bloor Street Viaduct will be received until April 11th by the Board of Control. Specifications at Room 12, City Hall.

Tenders will be received until April 11th by the Board of Control for quantities of asphalt, brick and bitulithic pavement and concrete curbs and sidewalks. Specifications at office of the Works Department, City Hall.

Chicago Issues New Rules for Sewer Trenching

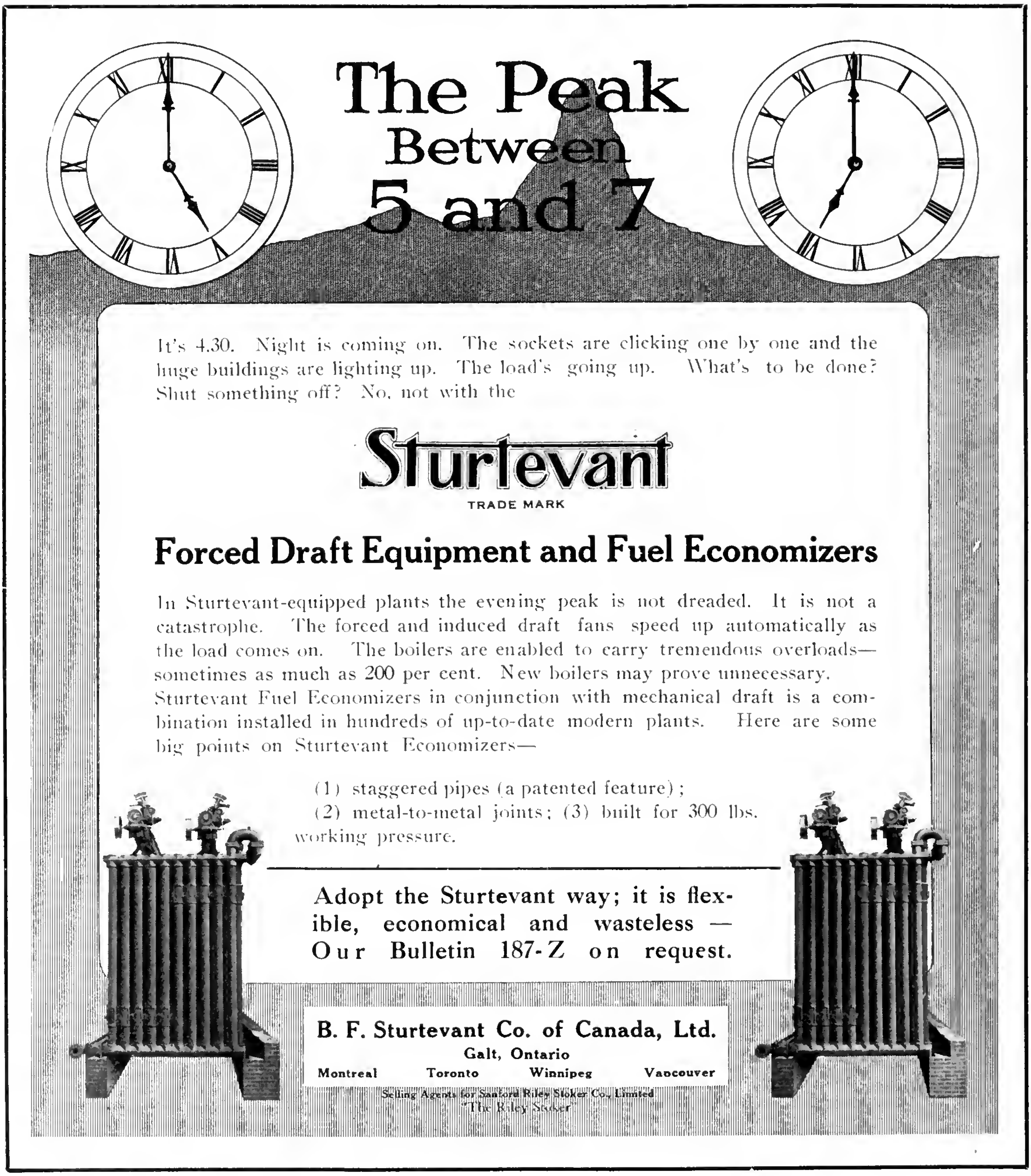
Utilities in the space to be occupied by sewers in Chicago are subject to new rules recently put out in standard specifications by the board of local improvements of that city. The principal features of interest to contractors relate to trenches dug by excavating machines and are as follows:

Utilities in the way of trench machines of the steam-shovel type used to excavate for a sewer 3 feet in diameter, or larger, must be removed and replaced without expense to the contractor. This diameter is reduced to 24 inches when machines of the endless-belt type are used. Below 24 inches the utility must be left in place and maintained at the expense of the contractor. Utility companies must take care of their lines when rock is to be blasted, provided five days' notice is given.

Where sewer trenches are excavated without the use of excavating machinery, except in rock, all utilities will be left in place and maintained at the expense of the contractor.

In paved streets utility companies must replaçe disturbed pavement areas outside the limit of the sewer trench.

Service lines, except water services, to buildings, must be removed without expense to the contractor on 48 hours' notice, when excavating machines are used, also all interfering aerial equipment must be removed or altered. The latter, however, will not be removed to accommodate backfilling machinery, except at the expense of the contractor. Somewhat similar rules are in effect with reference to water mains.



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Vol. 30 **April 12, 1916** **No. 15**

Principal Contents

Bad Management of Toronto-Hamilton Highway

THE Board of Control of the city of Toronto have taken the only possible course in agreeing to recommend the payment of an extra hundred thousand dollars to complete the Toronto-Hamilton highway. It would be exceedingly unwise to hold this work up at the present time when it is two-thirds completed and equally unwise to revise the original plans to the extent of saving money by constructing an inferior roadway. The whole scheme has apparently been badly managed, conceived in ignorance and carried forward in a way that these same men would never dream of handling their own private affairs. The management of this work, by the commission entrusted with it, is open to the gravest censure and road building in Ontario has been discredited to such an extent that it will take years to recover. The only ray of sunshine in the whole matter is that the province has learned its lesson and will know in future where not to look for highway commissioners. However, when we get in a hole there is nothing to do but get out of it as best we can and we are entirely in accord with the idea that this roadway should be completed as early as possible and that it should be built as permanently as the best engineering practice teaches us how to build it.

In censuring the mis-management of this commission, however, we must not overlook the fact that when the roadway is completed, expensive though it may be, we shall have fair value for money expended. It will be a good road, located where a good road is needed. That will always be some satisfaction to the people who paid for it, although they would not have built it, just now anyway, if they had been given full information in the first place. We hope the province will be able to live down the impression that has generally (and naturally) gone abroad that the cost of good roads is a gamble. Nothing could be farther from the facts. There is no doubt that if proper engineering advice had been sought the cost could have been determined beforehand to within a few hundred dollars. That this was not done probably merely indicated the unbusinesslike attitude of the commissioners.

Whether the lack of proper information was deliberate or simply due to a credulity born of enthusiasm we trust the province has paid a sufficient price for their experience, so that in our road work of the future we shall obtain definite advice on two points before committing ourselves to large expenditures, (1) the cost of the work shall be carefully figured by engineers of ample experience and facilities for learning all the conditions and, (2), the men who have been responsible for the mismanagement of the present work shall never again have a chance to get us into such a mess.

Should We Stop Recruiting in Ontario?

To the Britisher, to the Canadian, there is something repulsive about the word "conscription." Voluntary service has been so long recognized throughout the British Empire as the ideal form of military law that we do not take kindly to the thought of being compelled to shoulder arms. But in the face of what is happening in Canada, if we look right at the facts we cannot but feel that there is much to be said in favor of conscription.

What is the situation in Ontario? Recruiting has been carried on to such an extent and in such a haphazard manner that our industries are crippled, production is at low ebb, labor for the factory is unobtainable, and contracts which rightly belong to us are going to the United States. Ontario is suffering as the result of her activity in recruiting, a statement which cannot be made of certain other provinces of the Dominion. Conscription would remedy this inequality.

This war is a business and should be conducted in a businesslike way. Have we not recruited beyond the requirements? If we have not, why are battalions which were in camp at Niagara last year preparing to return there this summer? The time necessary to train a soldier is surely not a satisfactory answer—and all the time our industries crying for men.

Sir Robert Borden offered to send 500,000 men if required, but it would seem that the Minister of Militia's call for the second 250,000 has not yet been justified.

If we are recruiting more men than are required, it means a loss to the country and to the Empire. Every man's time should, in this crisis, be employed where it will be most effective.

The scarcity of labor is serious. The suggestion has been made that women take the place of men in the banks and offices and other business places, and that the men thus replaced who do not join the colors go to the farms. Yet in the face of this situation we find the Government appropriating $100,000 for a campaign in the daily newspapers to encourage increased production and thrift on the farm, where the supply of labor is already totally inadequate. There are grave economic problems before us. Can they be satisfactorily worked out under the present system of recruiting? What are the opinions of our readers?

The Brick Industry

What's the matter with the brick industry? This question has been raised very frequently of late, yet no one manufacturer seems prepared to say just what the reason is for the slump in the demand for brick as a building material, but each is willing to say what has happened in his own locality.

Brick today are fully 25 per cent. less than before the outbreak of war, while many other building materials have advanced, or remained constant in price. Lack of organization among brick manufacturers may be cited as the real difficulty in the brick industry—"United we stand; divided we fall" seems to be apt and timely.

Mr. W. B. Wreford, in a paper before the National Brick Manufacturers' Association, published in this issue unreservedly tells the brick manufacturers to pull together—advertise, create a demand for brick, and the price will very shortly adjust itself. He advocates a National Building-Brick Bureau to encourage advertising on the part of the brick manufacturer, to assist in preparing advertising material and in directing the lines of exploitation work, and to collect and furnish specific data for its members that would be of value in the promotion of brick as a building material against all competitors.

Speaking on the organization of the cement and lumber industry, Mr. Wreford quotes figures to show the annual expenditure in publicity campaigns spent each year by these industries. As a result the field of cement and lumber is world-wide, while that of the brick industry is usually confined to local communities where brick is manufactured. The cement industry has a department whose function it is to furnish such data as architects may require for their consideration of reinforced concrete, and to lend such aid as may be desired in preparing designs in which the reinforcing is very detailed. Such information is given free.

This seems to be the solution to the question—be alive, get together, create a demand, make people talk brick then they will buy and use it.

Toronto Branch C.S.C.E. to hold Luncheon

The Secretary of the Toronto branch of the Canadian Society of Civil Engineers, Mr. L. M. Arkley, has mailed the following notice to members:

The regular monthly meeting of the Toronto Branch of the Canadian Society of Civil Engineers will be held in the Chemistry and Mining Building of the University of Toronto on Thursday, April 13th, 1916. Professor A. P. Coleman, Ph.D., will give an illustrated address on "A Visit to the Mountains of Northern Labrador." Come and hear this very interesting address.

The executive of the Toronto Branch propose holding a luncheon at the St. Charles Hotel on Thursday, April 27th, inst., at 1 p. m., if we are assured of a sufficient attendance to justify our getting a good speaker for the occasion. Please state on the accompanying card if you will be able to attend, and return to the Secretary at an early date.

We have been asked by the Secretary of the Canadian Society of Civil Engineers, Prof. C. H. McLeod, to ascertain the names and standing of as many prospective members as possible in the vicinity of our Branch. Each member is therefore requested to return a list of such names to the secretary of the branch as soon as possible. Your prompt and hearty co-operation in these matters will be much appreciated.

Barge Replaces Trestle in Making Rock Fills at Halifax

By using a dumping bridge supported between the end of the fill and a large scow by an A-frame boom, the difficulties of building a trestle on rock bottom and maintaining it while making a rock fill have been avoided in constructing the Halifax ocean terminals in Nova Scotia. The stringers of the bridge are of timber, and are suspended from the A-frame at the centre of the bridge on the same principle as is used in swinging the gang plank of the familiar river steamer. Two 18-yard side dump cars at a time can be dumped from the bridge into clear water between the barge and the end of the fill. In order to save switching, the track extends the full length of the barge to accommodate four cars that have been dumped while the fifth and sixth are dumping. Thus the only loss over operation on a trestle is that the whole train cannot be dumped simultaneously. This is more than made up by saving the time and expense of building and maintaining a trestle on rock bottom in 30 to 60 feet of water.

The fill for the breakwater has been finished, that for the centre of pier B is now being completed, and that for the centre of pier A will be made in this way. All three are long, narrow fills built out from the end. Material from a heavy cut on the railroad approaching the terminal, for which the Cook Construction Company and Wheaton Brothers are contractors, is being used.—Eng. Record.

The Engineer at the Front

The Ottawa branch of the Canadian Society of Civil Engineers, are holding their fourth luncheon for the season at the Ladies' Cafe, Chateau Laurier, on April 13 at 12:45. Lieut.-Col. Melville, O. C. Engineering Training Depot, Ottawa, will address the members on the subject: "With an Engineer Battalion at the Front." Lieut.-Col. Melville has just returned from active service to assume charge of the Engineer Training Depot at Lansdowne Park in the city of Ottawa. He will describe the work and duties of the Engineer Forces at the front.

The cost of street cleaning at Victoria, B. C., is now 13.4 cents per 1000 sq. yd. This does not include plant rental and overhead charges. All the work is done with hand brooms, pick-up carts and cans. No flushing water is used.

Shall I Build Now, or Wait? Comparative Prices Today and at Outbreak of War

[Continued from April 5]

In our last issue we printed the first of a short series of articles which have for their object the publication of information which may enable the prospective builder, the architect or the general contractor, to compare the cost of building to-day with the cost a year ago or at the outbreak of the war. We discussed in that article more particularly the elements that enter into the initial stages of the ordinary building—stone, brick, cement and lime. Our figures for these items pointed to a considerable reduction in price, twenty-five per cent., and over in the case of brick and averaging anywhere from ten to twenty per cent. decrease. So far as these materials go to make up a building, therefore, it is less expensive to build today than it was at the date of the outbreak of war.

Just to what extent these four items enter into the cost of a building depends, of course, on the type of construction. In a steel structure it would be much less than in an ordinary brick dwelling or a factory or warehouse built chiefly of brick or cement, or both. Brick being the material that has shown the greatest decrease in price, it follows that those buildings that use a maximum of brick will profit the most by present conditions. In a residence, for example, where the cost of the brick alone may run from 15 to 20 per cent. of the total cost, the saving should be very considerable.

Labor

We must not overlook the important place occupied in this discussion by the item of labor cost. Generally speaking it probably would not be too liberal an estimate, on the average building contract, to allow one-third for the cost of the labor, as compared with two-thirds for material laid down at the job. For the purpose of argument anyway this estimate is near enough. Carpenter labor would run nearer one-half; painting, tinwork, etc., still higher. Now what is the condition with regard to labor?

It may truthfully be argued that labor is scarce, but equally truthfully that building work is scarce. The war, so far as the workman who has stayed at home goes, has been a godsend in sidetracking what would otherwise have been one of the most troublesome labor problems of recent years. Even at the moment it is by no means proven that there is a shortage of labor for such building work as there is in hand. For example, it was announced only the other day that twelve per cent. of a certain trade had responded to the call to arms. This still leaves 88 per cent. to attend to construction work that does not run to more than half, and in many cases to not more than ten per cent. of what was going forward three years ago. Many of these men have, of course, changed their occupation, but it is not characteristic of a mechanic to want to do other work than his own except under compulsion. The result is that labor to-day in very many lines of the building trades is easier to get than it was a year or two before the war and consequently costs less. A comparison between labor costs to-day and at the outbreak of war probably shows that wages have advanced but slightly. The labor market, however, is uncertain and subject to influences from the United States. It does not appear that the removal of a half million men from this continent should cause any serious shortage in mechanics, though it may cause us a little temporary delay and inconvenience.

Lumber

The other big item is lumber, under which mill-work is generally included. Lumber, not including carpenter's wages, usually accounts for somewhere between 15 per cent. and 20 per cent. of the total cost of a private residence. In a factory it may be less, in an office building more, all depending on the individual requirements. Lumber prices shortly after the war broke out showed signs of weakening, but it seems to be a fact that the lumbering trade, though they do not deal to any great extent in war materials, have been able to adjust their business to conditions with a fair degree of satisfaction to themselves. The result is that prices to-day are about the same or slightly in advance of what they were in August, 1914, though still considerably less than in the boom years of 1912-13.

Mill-work stands in about the same position as lumber—slightly advanced over prices of two years ago. The future of mill-work prices is dependent to a more considerable degree on labor conditions, material being a less important item.

However, though both of these items are inclined to show slight increases it must be taken into consideration that contractors are eager for contracts today and willing, rightly so, we believe, to accept work at actual cost so as to be able to take care of their overhead and keep their organization together. This may, or may not, offset the increase in the price of lumber and mill-work. We are inclined to think it would.

(To be continued)

Irrigation Dam

Arrowrock Dam, in Idaho, is the key to an irrigation system that is transforming 234,000 acres of barren sagebush desert—adjacent to Boise, the State capital—into fruitful gardens, orchards and farms. By throwing a dam across a gorge in the canyon twenty-two miles above the city the channel of the river is converted into a reservoir running back eighteen miles into the mountains. It holds, when full, 244,000 acre feet of water, enough to cover 381 square miles to the depth of one foot. It will reclaim 234,000 rich acres in the Boise Valley. Arrowrock is the highest dam in the world to-day, 348.5 feet from the low point in the foundation to the sixteen-foot driveway over the top. It is 240 feet thick at the base and 1,060 feet long. The great mass is below the bed of the river; it was necessary to go down 91.5 feet through volcanic rock to reach a solid foundation in granite. In its construction 530,000 cubic yards of concrete were used.

The Department of the Interior, Ottawa, have just issued a report of the progress of stream measurements (hydrometric surveys) for the calendar year 1914, prepared under the direction of F. H. Peters, Commissioner of Irrigation, by P. M. Sander, chief hydrometric engineer, assisted by G. H. White and G. R. Elliott.

Dale Presbyterian Church, Toronto

The "Roofless" Church finally becomes one of Toronto's most beautiful edifices — Capacity 2000 — Cost $90,000

THE culmination of seven years of unceasing endeavor and self-sacrifice by the Rev. J. D. Morrow and his congregation came on Sunday, April 2nd, when the new Dale Church was dedicated and the "roofless church" became a thing of the past.

In 1873 "New" St. Andrew's Church, King Street, started a mission on the then outskirts of the city, at King and Tecumseh Streets. In 1889 this small wooden structure, known as St. Mark's Mission, was moved to one side and St. Mark's Church, a plain red building, became the house of worship. At first St. Mark's was not very prosperous, being situated in a district where honest poverty was the rule and prosperity the exception. But in 1905, with the advent of the Rev. J. D. Morrow, things brightened so considerably that in 1908 the condition of affairs proved the dire necessity of a larger church.

Robert F. Dale, a retired baker, and a member of St. Mark's for some years, showed his appreciation of Rev. J. D. Morrow's work by giving the present site at the corner of Bellwoods Avenue and Queen Street to the congregation. The old building was sold and on July 24, 1909, the first sod of the new site was turned.

"Pay as you go" was the principle upon which the Rev. J. D. Morrow insisted, and the "going" was no faster than the "paying"—which was pretty slow. But J. D. Morrow never wavered; he worked on with faith and persistence ably supported by his congregation, and his efforts were finally rewarded in the dedication of the new church last week.

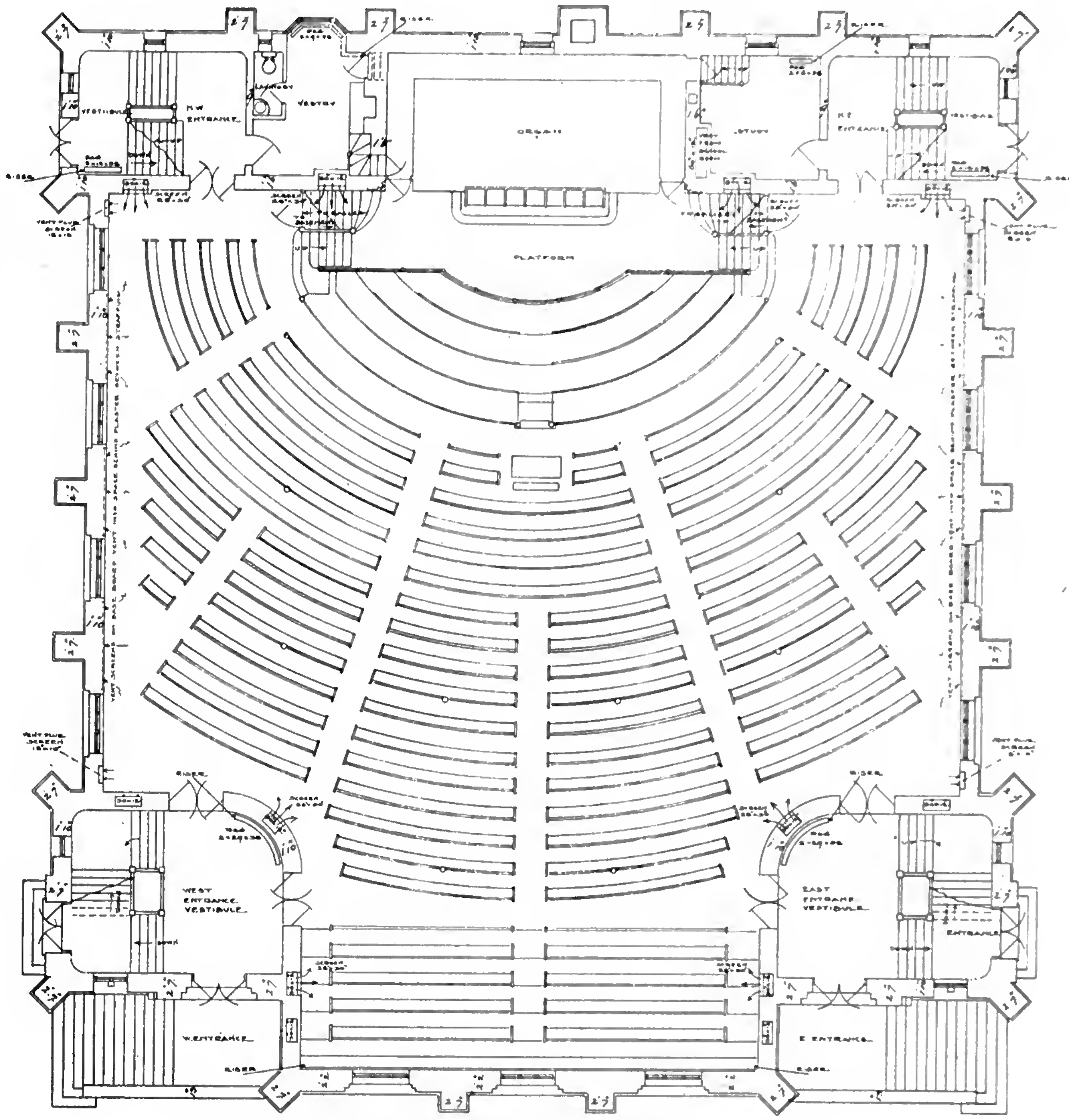
The church is situated on the corner of Queen Street and Bellwoods Avenue, fronting on Queen Street. Entrance is made through two large entrance vestibules in the south-east and south-west corners, and through two side vestibules in the north-east and north-west corners. The main vestibules have double entrances—one off Queen, and one on a side street.

The church, which is 90 ft. by 106 ft., is in the Perpendicular Gothic style, built of brick for the main body, with stone for the Sabbath school, the whole being set on concrete foundations. Difficulty was experienced with the foundations, which were laid in 1909, the western portion of the site being composed of artificial fill over boggy ground. This necessitated sinking the foundations very deep to procure a good bearing. The east side of the site, however, was good clay, necessitating only a relatively shallow foundation. The foundations cost approximately $2,000.

Auditorium

The auditorium, or church proper, has a seating capacity of 1,700—probably the largest percentage per square foot of floor space of any church in Toronto. One of the special features that attracts the attention is the fan-shaped choir loft, situated in front

Fig. 1—Dale Presbyterian Church, Queen St. and Bellwoods Ave., Toronto.



AUDITORIUM·FLOOR·PLAN

Fig. 2 —General Floor Plan Auditorium, seating capacity 1700.

of the platform. The latter, 44 ft. by 10 ft., is accessible on both sides from both the auditorium floor and the gallery.

The organ loft is directly behind the speaker's platform, and is closed in by an artistic open screen. This screen work is backed in the lower larger arches by heavy curtains, and in the upper smaller ones by bronze netting and entirely excludes all view of the organ pipes. The screen is artistically decorated and streaked with gold, adding materially to the beauty of the church.

The vestry on the west side of the organ loft is about 12 by 12 ft., and is completely fitted with all modern conveniences. On the east side is a similar room used for a study. Another special feature has been installed at the back of the auditorium where the space between the main vestibules under the gallery can be completely closed off by means of rolling doors and used as a prayer room or baptistry. The same system has been adopted in the Sabbath school below. The gallery extends completely around the auditorium, and is accessible from the main entrance vestibules, the side entrance vestibules, and from the choir loft. It is supported by marble pillars with ornamental cappings, and faced with an oak railing.

The floor of the auditorium is reinforced concrete supported by pilasters, and is probably the only one of its kind in a church in Toronto. It has a slope of between 4 and 5 feet front to rear, and is covered with ⅞-in. oak flooring. The interior trim and fittings throughout the church are oak. Special attention has been given to the design of the pews, which are most comfortable. Individual choir chairs have been provided in the choir loft.

Acoustic Properties

The roof of the building is a steel truss, with probably the largest unsupported span of any Canadian church, being 90 ft. between walls. The steel work is entirely closed in, and the decorated ceiling presents an even, unbroken surface, free from any obstructions, which has made possible the remarkable acoustic properties of the church. With the exception of ten small marble pillars supporting the gallery, there are no obstructions of any kind in the church, which is probably unparalleled in Toronto for the remarkable ease with which the speaker can be heard in any corner of the building.

capacity of 1,000. Above the vestry and study rooms, on the gallery floor, are two choir rooms, and above these, across the whole north end of the building, are large recreation rooms and work rooms for young men, and across the south end similar recreation rooms and committee rooms for young women.

The church was designed by Herbert G. Paull, architect, 395 College Street, Toronto, and was built by E. T. C. Poole. The building was constructed by day labor, at a total cost, including material, of $90,000 —financial matters being left in the hands of the architect. Sub-contractors on the work were: concrete foundations and reinforced floors, John Leach & Company; stone work, Cement Products; steel, Hepburn & Disher; brick, Walker Morley; plaster, Balmer & Blakely; interior decorations, Doxee; windows,

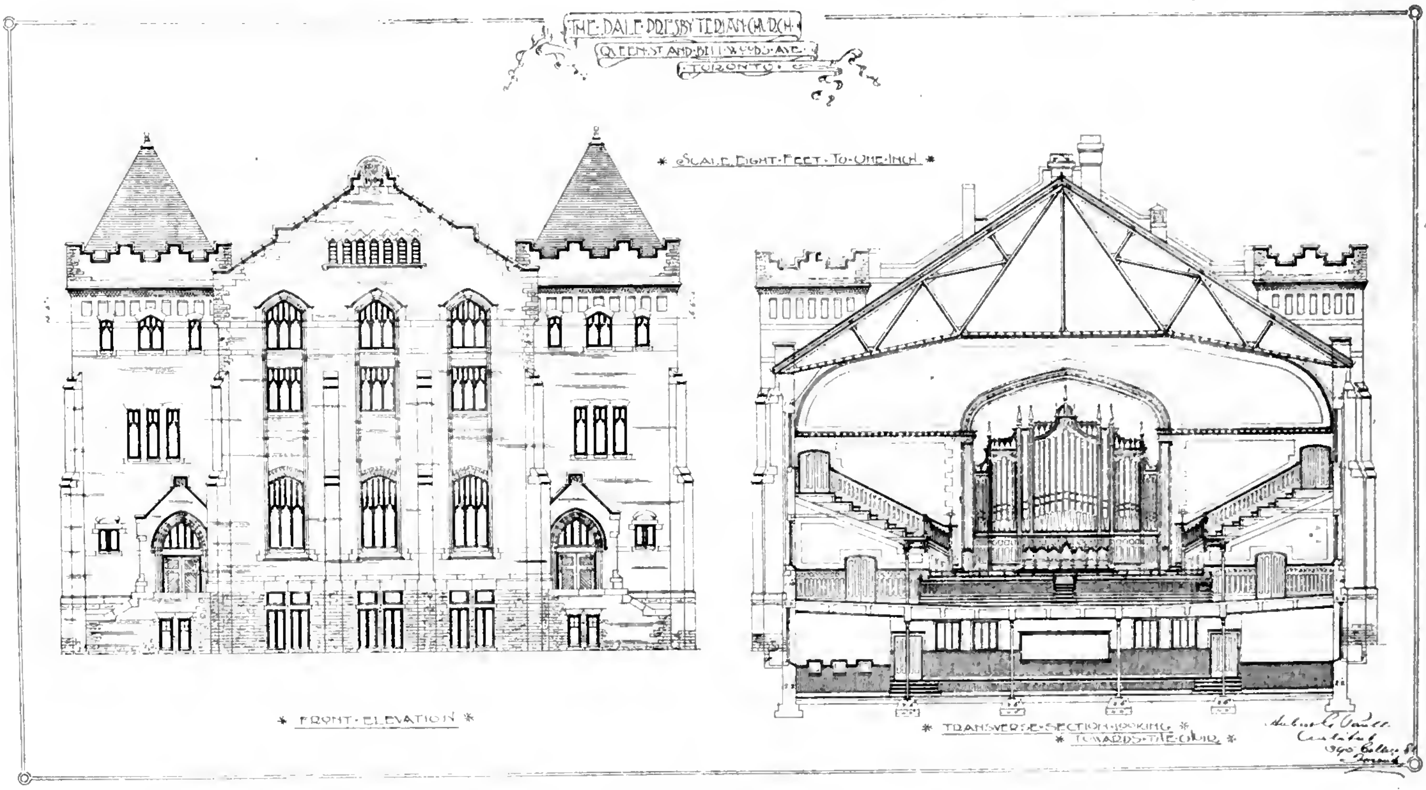


Fig. 3—Queen Street Elevation and Section, showing choir and organ lofts, also section of roof-span.

The steel roof is covered with asbestos shingles. Steel lath is used throughout, and the windows are leaded art glass with cut-stone sashes. The stairs are of fireproof, iron construction, with mastic treads.

Light and Ventilation

Every attention has been given to the lighting, heating, and plumbing. Semi-indirect lighting is used in the auditorium, light being diffused uniformly from forty-five suspended indirect lights. Heating and ventilation is by hot air heated by direct steam; cold air is drawn in by a large fan, heated, and distributed throughout the building through openings in the walls and ceilings, foul air being drawn off by automatic ventilators. A complete change of air is effected every ten minutes.

The church is finely and beautifully decorated in soft, pleasing tints—bright, yet not gaudy—providing a sense of restfulness and comfort.

Other Features

The Sunday school in the basement, which has been used in the meantime as a church, has a seating

Queen City Glass Company; lighting fixtures, Knight Brothers; iron stairs, Ever Hardwood Company; mastic treads, Johns Manville; rolling doors, Watson Smith.

The buying movement in structural steel is now probably greater than it has been at any time since 1906. According to a Pittsburgh press dispatch contracts for fully 500,000 tons of this material were pending last week. Bridge contracts placed in February were the largest in a single month for the last six years, and it is expected that the tonnage ordered in March will be even larger than that of the previous month. The steel industry is having the greatest period of prosperity in its history.

In the Contract Record of March 29 we printed a brief description, with illustration, of a new expansion joint recently placed on the market by the Barratt Company of New York. This material may now be obtained from the Paterson Manufacturing Company, Limited, of Toronto and Montreal.

The Determination of the Physical Properties of Road-Building Rock

By Provost Hubbard and F. H. Jackson, Jr.*

It is now generally recognized that any stone, to be suitable for use in macadam construction, must possess to a certain degree, depending on circumstances such as character of traffic and method of construction, three distinct physical properties, which may be briefly defined as follows:

(1) Hardness, the resistance which a rock offers to the displacement of its surface particles by abrasion;

(2) Toughness, the resistance which a rock offers to fracture under impact;

(3) Binding power, the ability which the dust from the rock possesses, or develops by contact with water, of binding the larger rock fragments together.

Of these, the first two are of particular interest from the standpoint of the present discussion, and they may be very briefly described as follows:

The degree of hardness of a rock is determined by what is known as the Dorry method. It consists essentially of subjecting a cylinder, 25 mm. in diameter, of the material to be tested to the abrasive action of crushed quartz sand fed upon a revolving steel disc, against which the test specimen rests. The end of the specimen is ground away in inverse ratio to its hardness, so that the hardness may be computed by determining the loss in weight after any given number of revolutions of the disc. The coefficient of hardness discussed later is obtained by subtracting one-third of the loss in weight in grams from 20, after 1,000 revolutions of the disc.

Toughness

The degree of toughness is determined by the Page impact method. A cylinder 1 in. in diameter and 1 in. high, cut from the rock specimen, is subjected to the impact caused by the free fall of a 2-kgm. weight dropped from successively increasing heights until the energy of the blow is sufficient to fracture the test specimen. The test consists of a 1-cm. fall for the first blow, followed by falls increased by 1 cm. after each blow until failure occurs. The height from which the weight drops when failure takes place is used as a measure of the toughness of the material.

Since the establishment of the road-material laboratory by the United States Government, upwards of 3,000 samples, representing every known variety of road-building rock, and obtained from every State in the Union, as well as from foreign countries, have been subjected to the tests outlined above. The results of these tests are plotted in graphic form, in a curve in which the coefficients of hardness are plotted as abscissae and the factors of toughness as ordinates. Small circles represent the corresponding hardness and toughness of an individual rock sample. Large circles represent the average of all the coefficients of hardness for each value of toughness. Hardness values range from 0 to 20 and toughness values from 1 to 47.

A study of this curve brings out the following points:

(1) That the average toughness for all tests made is about 9.

(2) That the average hardness increases with toughness, and that the rate of increase becomes less as the toughness values become larger.

(3) That individual values of hardness vary through wide limits for low values of toughness, and that the variations from the average decrease uniformly with the increase in toughness up to a certain point, about 20, after which they remain constant with very little variation from the average.

(4) That, when any given value for toughness falls within certain limits, which define the suitability of the material for macadam-road construction under different traffic conditions, the corresponding value for hardness will fall within similar limits for hardness.

The first three facts are clearly indicated, but in order to substantiate the last deduction it will be necessary to define the limiting values of hardness and toughness which experience has shown should be applied when judging the fitness of stone for use in macadam construction under different traffic conditions. Such limiting values for toughness are shown on the curve in the ordinates at 4.5, 9.5, and 18.5, and the corresponding limiting values for hardness at 10, 14 and 17. In other words, after making all allowances for variations due to local conditions, it may be fairly assumed that stone for use under light, horse-drawn, steel-tired vehicles should show a toughness of from 5 to 9 and a hardness of from 10 to 17; for moderate traffic a toughness of from 10 to 18 and a hardness of over 14, and for heavy traffic a toughness of 19 or over and a hardness of 17 or over. The terms "light," "moderate" and "heavy" in this connection refer to the total volume of traffic upon the road, calling, say, under 100 teams a day "light," 100 to 250 "moderate," and over 250 "heavy."

Practically all the values of hardness shown in the figure are above the various lower limits set by the best water-bound macadam-road practice.

For light traffic conditions, 94 per cent. of all the samples tested have a hardness of more than 10; for moderate traffic, 95 per cent. have a hardness of more than 14; and for heavy traffic, 94 per cent. have a hardness of more than 17.

Light Traffic

A large number of hardness tests appear above the upper limit of 17 set for light traffic conditions. Although on its face this would indicate that a determination of the hardness is necessary in this instance, reference to test records show that by far the greatest number of these tests (about 75 per cent) are on granites, quartzites, and hard sandstones, which are unsuited for use in the wearing course of water-bound macadam roads, owing to their lack of binding power, as shown by actual test.

Finally, the results of 2,500 individual routine tests made by the Office of Public Roads and Rural Engineering show that for practical routine work the hardness test adds nothing to our knowledge of the value of any particular rock sample for use in water-bound macadam-road construction over that obtained from the toughness test.

While the binding or cementing value of a rock is a most important consideration from the standpoint of

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ordinary macadam construction, the same is not true of broken stone roads which are surface treated or constructed with an adhesive bituminous material. The hardness of the rock is also of relatively less importance, owing to the fact that the fine mineral particles produced by the abrasion of traffic combine or should combine with the bituminous material to form a mastic, which is held in place and protects the underlying rock from abrasion so long as by proper maintenance it is kept intact. The toughness of the rock, however, is of more importance, as the shock of impact is to a considerable extent transmitted through the seal coat, and may cause the underlying fragments to shatter. It would therefore seem that the minimum toughness of a rock for use in the construction of a bituminous broken stone road, or a broken stone road with a bituminous-mat surface, should for light traffic be no less than for ordinary macadam subjected to the same class of traffic. For moderate and heavy traffic, however, the same minimum toughness may probably prove sufficient, owing to the cushioning effect of the bituminous matrix. No maximum limit of toughness need, however, be considered for any traffic.

In the case of bituminous concrete roads, where the broken stone and bituminous material are mixed prior to laying and consolidation, it would perhaps appear advisable to set a minimum toughness of 6 or 7 for light traffic roads instead of 5, in order to insure against the possibility of the fragments of rock which have been coated with bitumen being fractured under the roller during consolidation, and of 12 or 13 for moderate and heavy traffic, instead of 10 and 19, as in the case of water-bound macadam roads.

For broken stone roads which are to be maintained with dust palliatives, it would appear that the same limits of toughness should hold as for ordinary macadam.

For easy reference the following limits of toughness are given in Table 1, as representing facts developed in the foregoing discussion. It is, of course, quite probable that these limits will require modification as the correlation of laboratory tests to service results becomes more perfect.

TABLE I.

Limits for toughness for rock used in the construction of broken-stone roads.

Type of road.	Light traffic. Minimum.	Light traffic. Maximum.	Moderate traffic. Minimum.	Moderate traffic. Maximum.	Heavy traffic. Minimum.	Heavy traffic. Maximum.
Macadam						
Macadam with dust palliative....	5	9	10	18	19	—
Macadam with bituminous mat						
Bituminous broken stone with carpet coat	5	—	10	—	10	—
Bituminous concrete with or without carpet coat	7	—	13	—	13	—

New Monnoyer Type of Cement Block Chimney at Quebec

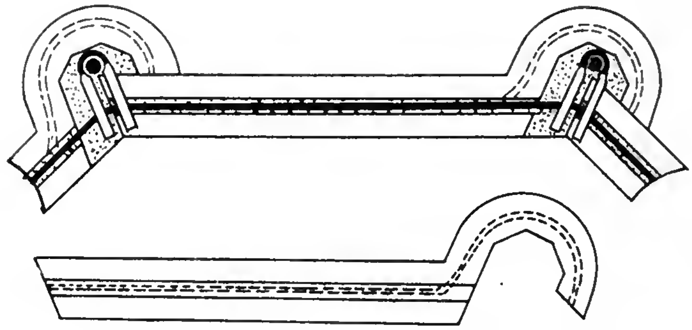
A contract for a new cement block chimney for the Monastery of the Franciscan Fathers, Quebec, was recently awarded to Eduoard Pelletier & Fils, Quebec. The chimney will be 65 feet in height above the ground level, with an inside diameter at the summit of 2 ft. 6 ins., and at the base of 5 ft. 3 ins. Foundations for the chimney will be carried down to rock, about 5 ft. below the ground level. The flue opening will be above the ground level, and will be 3 ft. high by 2 ft. 6 ins. wide, to be built of reinforced concrete. The vertical reinforcing rods of the foundation will be extended into the footing almost to the base, and will be continued above the substructure, overlapping and bonding with the vertical reinforcing of the substructure for four or five feet.

The shaft of the chimney is to be constructed on the Belgian "Monnoyer" system. Blocks are cast ten inches in height, for average diameters, with a hook or hollow projection at one end, as shown. The opposite end is tapered at an angle fixed by the diameter of the chimney and the number of blocks per course. Blocks are cast in a steel form, being mixed rather dry, and on removal from the form are sprinkled regularly for about a week before being used in construction. Blocks are reinforced horizontally, as shown in the lower cut, and are moulded with a horizontal groove on the top face, in which horizontal reinforcement is laid every course.

The method of erection is to place a course of blocks, the number of which vary according to the diameter of the chimney, the blocks being set with the hook around the vertical reinforcement, and the square end set into the head of the adjoining block, as shown. The head room is sufficient to allow considerable latitude in setting to permit of adjustment in the diameter of successive courses, thus making it possible to obtain a conical shape, which is so much more desirable than the cylindrical form.

The operation of erecting is effected very rapidly; masons working in the interior of the chimney, receive their blocks ready to lay, put them in place, mortar the 10 inches in the interior of the rib, prepare the joints for the new blocks, and continue very rapidly to lay them.

The chimney will be terminated at its summit by two bands of specially constructed blocks and a cast iron coping.



Monnoyer Type of Cement Block—Showing shape of block and manner of laying.

The concrete for the blocks consists of a 1-2-4 mixture and is placed in the steel forms in a semi-dry state, the reinforcing rods inserted and the whole well tamped. For the mortar forming bonds between the blocks, a mixture of one of cement and two of sand is used. The chimney will be lined inside with 4 ins. of fire brick set in fire clay, to a height of 15 feet below the smoke flue. A sectional steel ladder will be built up along with the erection of the chimney, the supports being tied into the vertical reinforcing rods.

Aerial Cableway over Niagara River

Torres System of Constant Tension Steel Cables Supports a 46 Passenger Car over Whirlpool Rapids — Cost $60,000

A NEW scenic pleasure device in the form of an aerial cableway over the Whirlpool Rapids, Niagara River, has recently been completed at Niagara Falls, Ont. The span is said to be the longest in the world, being approximately 1,800 feet. The Niagara whirlpool is about three miles below the Falls, and is almost entirely in Canadian territory. The cableway has both anchorages within the province of Ontario; yet it crosses a point in the boundary line, and for that reason international consent was necessary for the promotion of the project. The cableway, which is based on a Spanish patent, was built by the Niagara Spanish Aerocar Company, Limited, Gonzolo Gorres y Polanco, C.E., chief engineer and vice-president of the company, to whom we are indebted for the following information.

Anchorages

The design of the anchorages, both of which are on the Canadian side, one at Colt's Point and the other at Thompson's Point, was governed largely by the fact that the cableway was not allowed to cross the tracks of the Niagara Belt Line Railway, that the appearance of the cliffs on neither side of the whirlpool should be altered and that no towers or structures should rise above the level of the track of the railway which runs along the cliff.

The passenger car is suspended from a running gear which travels on six parallel track cables of 1-in. crucible steel rope. Each cable is anchored securely at Colt's Point by means of a 2-in rod bent into an anchorage in a 740-ton concrete block. At the other terminus each track cable passes over a sheave and is fastened to a counterweight or stretcher. Boxes 12 ft. high by 6 ft. 7 in. wide by 11 in. deep, made of riveted steel, contain cast-iron weights sufficient to make a total of 10 tons for each track-cable counterweight.

Each track cable is entirely independent of the others. The breaking of any one of them would not be serious, as the other cables would support all the weight of the car without any increase in their tension. The car would drop several feet suddenly, and, after a few vertical oscillations, would assume a new position of equilibrium.

Thus, the breaking of one cable does not imperil the passengers, and the breaking of two cables at the same time would be nearly as improbable as the simultaneous breaking of two cables belonging to totally separate installations.

Central Tension System

The simplicity and safety of this system lie in the fact that each cable is put into fixed tension from the start of operations, that this tension never varies, that the resistance of the cables can be verified at any time by increasing the load on the weight boxes, that if any cable or fastening is faulty it will probably break when heavily weighted for trial or inspection trips, and that if a cable does break practically no extra strain is put upon the other cables.

The car built for Niagara provides seats for 24 passengers, and standing room, in a raised aisle in the centre of the car, for 21 more, besides the conductor. The weight of the car empty is 3½ tons, fully loaded 7 tons. It is 10 ft. 10 in. wide, 24 ft. long and 23 ft. high. It was manufactured complete in Spain, and assembled here.

The car is propelled by a ⅞-in. 6 x 19 plow steel traction cable, fastened to one end of the car. This cable passes over a sheave on Colt's Point, runs back across the Whirlpool, over a sheave in front of the Thompson's Point station, and to the driving sheave. From here is passes around three sheaves, to one of which is fastened a 10-ton counterweight box, arranged in guides similarly to the track cable counterweights, and this creates a tension in the cable which adjusts any slack caused by the rising and falling of the car. After passing around another groove in the driving sheave, the traction cable passes out to the other end of the car.

Motive Power

The 8-ft. driving sheave is turned by a 75-h.p., 3-phase, 440-volt, 480 r.p.m. Westinghouse motor, through a 30 to 1 Hindley worm gear, giving a speed to the car of about 400 ft. per minute when the controller is at full speed. The trip can be made in about

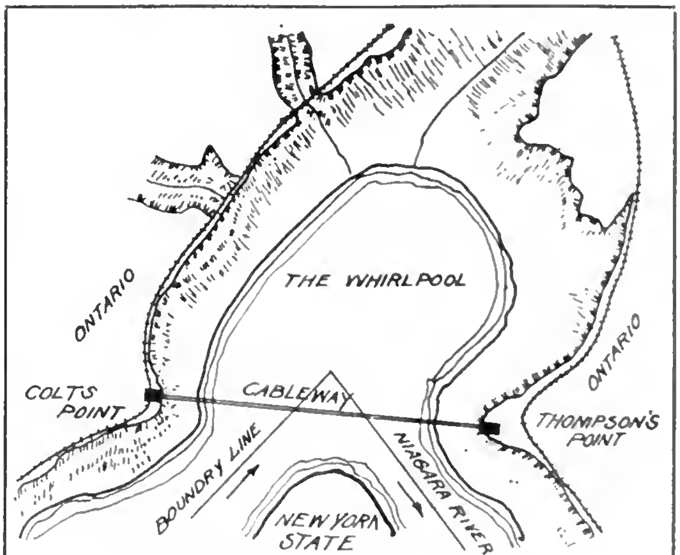


Fig. 1 Sketch showing location of Cableway.

4½ minutes, but it is planned to permit it to occupy six minutes by running at half speed part of the time.

To provide against breakdown of the motor, or interruption in the power supply, there is a clutch in the driving shaft by means of which the motor can be disengaged, and a 5-h.p. Gray gasoline engine engaged both through a worm gear and through sprocket wheels. The speed at which the gasoline engine would haul in the car would be very slow, but it would be ample to meet the emergency.

If the traction cable were to break during a trip, the car would oscillate backwards and forwards along the track cables until it would come gently to rest at the lowest point of the sag of the cable, which would be about the centre of the span, as the two terminals are nearly at the same height, one being 249.5 ft. above the river level, and the other, 246.5. To bring the car back to Thompson's Point in such an emergency, a relief car and a relief traction cable are available. Attached to the driving sheave shaft, and running idle ordinarily, there is a drum on which a ½-inch wire rope is coiled, with one end fastened permanently to the drum. After the breaking of the traction cable, the free end of the relief cable would be fastened to the relief car, a light basket which holds one man and which hangs from pulleys that can be readily thrown over two of the track cables. The driving sheave would then be reversed slowly, paying out the relief cable until the man reaches the car. After the relief cable is fastened to the car by chains provided for

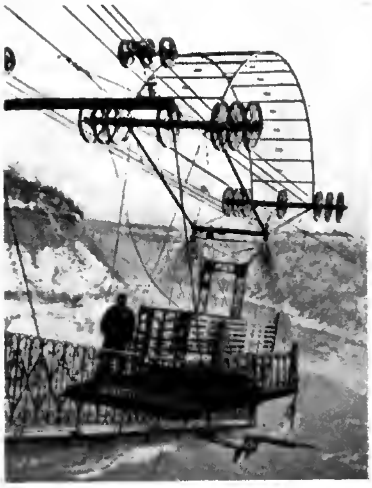


Fig. 2—Aero car and cableway.

Fig. 3—Automatic control stop.

the purpose, the driving sheave would haul the car back to Thompson's Point.

One thousand cubic yards of earth and 2,500 cu. yds. of rock were excavated for the two stations. The station at Thompson's Point is cut out of the solid rock and lined with concrete and buff tapestry brick. Two flights of concrete steps provide entrance to and exit from the landing platform. The footings for the track sheave towers and for the traction sheave tower are concrete. The towers are steel.

At the opening of the station a horizontal steel platform, 9 ft. 10 in. long by the full width of the opening, is hinged. At the outer edge of this short platform there is hinged another platform, 38 ft. long, extending over the edge of the cliff. The latter platform is suspended from the track cables by wire ropes and pulleys at the outer corners and at the hinged corners, each rope being fastened to three pulleys, one on each of three track cables. All four ropes are of the same length, so that the long platform always hangs parallel to the track cables, whatever inclination the latter may take; the four ropes are of such length that the platform clears the bottom of the car by 6 in.; therefore, the car always comes right onto the platform. The platforms are guarded at the sides by railings.

At Colt's Point a similar landing extends from the foot of the anchorage, and two flights of concrete steps lead up to the ground level.

Automatic Control

An automatic control stop is provided at each terminus which stops the car without jar within 3 ft. 4 in. The stop can be seen extending from the face of the concrete block in Fig. 3. The traction cable runs longitudinally through the 5-in. pneumatic cylinder and through the centre of the piston. A clamp on the traction cable, just ahead of the car, strikes the face of the piston, and also engages with it in such manner that the car cannot slip back from the landing platform. There are gates at both ends of the car, operated by the conductor by means of a crank, and these gates cannot open until the clamp has engaged with the stop piston, releasing a ratchet under the car. Even then, only the right gates can be opened; that is, the gates at the end of the car where the clamp has engaged. When the car starts, the clamp is disengaged by another crank, but this cannot be done until the gates are shut. This is contrived by interlocking discs, enclosed in a locked box on the car.

After the traction and track towers and sheaves had been erected, a very long rope was carried around the face of the cliff from Thompson's Point to Colt's Point. This rope was then hoisted over the tops of the trees until it could be pulled taut from Point to Point. A ½-inch wire rope was pulled across with the aid of a hoisting engine, and then the ⅞-in. traction cable was pulled into place.

Cables

The strength of the track cables is 92,000 lbs. each, allowing for bending over sheaves, and the working tension is 20,000 lbs., so the factor of safety is 4.6.

The maximum torque of the motor is 2.5 times the torque required to haul the car when fully loaded.

The maximum pull on the traction cable idler at Colt's Point is 28,000 lbs. The pull on each of the six carrying cables is 20,000 lbs., For any position of the car, the tension in the lower traction cable between the car and the transmission sheave equals half the counterweight, or 10,000 lbs., neglecting friction of counterweight and sheaves. The tension in the remaining part of the traction cable depends on the position of the car, varying from 6,000 lbs. when the car is at Thompson's Point to 14,000 lbs. when the car is at Colt's Point. The traction cable has a strength of 70,000 lbs., so this allows a factor of safety of more than 4, after deducting from strength of cable for bending over sheaves.

The sag of the track cables unloaded is 47.6 ft. The maximum sag when loaded with car and passengers is 100.1 ft. The car will still be 148 ft. above the surface of the water at the point of maximum sag.

The cost of the Niagara project was nearly $60,000 for labor and materials alone, being exclusive of the cost of engineering and other expenses, and exclusive also of the loading platforms and car, both of which were built in Spain.

The general contractors were Norman McLeod, Ltd., Toronto, on a cost plus percentage basis. The superintendent in charge of the construction was Lewis S. Roy. J. E. Taylor was resident engineer, representing Wright & Howard, consulting engineers, Toronto, who were employed by the Spanish company to adapt their design to local conditions, and who prepared the plans and supervised the construction.

Building operations in connection with the Jeffrey Hale Hospital, Quebec, will probably be commenced some time in May. The amount involved is $70,000. It is intended to extend the already existing wards, to remove the old power house and erect a new one. Another building project in Quebec is the erection of a structure for the Young Women's Christian Association on Ann Street. Tenders have been invited, and it is expected that the work of construction will be begun shortly.

Municipal "Clean-Up" Campaigns

Various Methods and Plans as Employed by U. S. Cities — Organization — Programmes — Benefits Derived (Con.)

THE greatest factor in the "clean-up campaigns" is the children, for nothing that has been done could have been accomplished without their help. Of the hundreds of cities interested in the clean-up campaigns very few can be found where the school children have not been actively identified with the work. And the co-operation of the school children is most important. No stone has been left unturned to encourage the teachers to give the children the clean-up spirit. One of the best means of reaching adults is through their children, and the education of the children themselves along these lines will contribute materially to their sense of proper community conditions when they become men and women. It is acknowledged that what is most needed in a boy nowadays is the right spirit, to insure him of a clean life in talk, habits and associates; keeping the city's streets clean is a certain responsibility that makes him more careful in his own habits. The State of Ohio spends $3,000,000 a year to produce such a boy.

Children have been pressed into service in many ways—through clubs composed of boys and girls, boy scouts, camp fire girls, city clubs, junior league clubs, junior civic clubs, etc.

There are various ways of rewarding the children for their work. Some cities believe that money prizes appeal to the children more than medals, badges, etc., and so have created special funds for that purpose, usually collected by some civic organization. Other cities give medals, buttons, puzzles, school equipment—stereopticon with lantern slides, maps, pictures, plans; sporting equipment—baseball and football masks, balls and bats; cameras, free tickets to moving pictures theatres, etc.

In some instances the school children have become enthusiastic to the point of organizing magazines in the schools, devoted entirely to the "clean-up" campaign.

Boy Scouts

Everywhere the boy scout has found his level in the "clean-up" campaigns. It is a scout law that he must be clean, and he is an expert in sanitation. Almost every troop of scouts has done its full quota in civic, local or county clean-ups. In patrol (8 boys) or by troops (24 or more), they care for school grounds, public grounds, make systematic campaigns against flies and mosquitoes, destroy their breeding places; plant trees, bushes and shrubs; in general, keep the streets free of litter and waste of all kinds. Divided into squads, they do much for city betterment. Vacant lots, waste property, fields and streets are rid of tin cans, bottles, scrap iron, weeds, and in their places flowers, vegetables and shrubbery planted; unsightly billboards removed.

In many cities the Scouts have done particularly splendid work in inspection duty, reporting all unsanitary conditions. In patrols, troops or companies (40) they are assigned to investigate and report to the superintendent of streets or the organization having charge of the "clean-up". The inspection is done day by day as the clean-up progresses, and any oversight or unsanitary condition reported at once.

City Clubs

Another method of interesting children is the organization of boys and girls into what is known as City Clubs, whose duty it is to keep the streets clean. The clubs are limited to 25 members each. The members wear buttons and each one is provided with blanks on which to report. In some instances these clubs work throughout the year, but usually their work is confined to the spring clean-up, in which event they attend to the general clearing up of vacant lots, back yards, school property, and cart it to the curbs for the city dump wagons to haul away. Chicago is one of the cities using these clubs.

In Boston, the Junior Municipal League, under the auspices of the Women's Municipal League, loaded with posters reading, "Do you have pride in your city? Then clean it up," and armed with brooms, shovels and rakes, proceeded to clean up.

Clean-up Plays:

A school in one city presented a one-act play typifying the following characters: Fly, waste paper, fire, soot, dirt, microbe, sickness, death, sorrow, poverty, cleanliness, swatter, refuse pail, fire protection, paint, scrub brush, soap, water and flowers. Lines were fitted to each character, and in the end cleanliness and happiness overcame sickness and dirt.

Although not always taking an active part in the cleaning up, women's clubs have been a great factor for good in instigating general clean-up. There is scarcely a city in the country where the women in one way or another have not done much propaganda work, and in many instances offered active service and financial support. Taking pictures of unsanitary conditions is a favorite method of bringing such conditions to the notice of citizens and health officials. Lectures on home and community gardens was one of the features of Cincinnati's campaign. One of these lectures was furnished by the National Cash Register Company.

To meet the demand for lecturers in Cincinnati, the Speakers' Committee secured the services of a number of speakers, who addressed the welfare associations, mothers' clubs, business associations, district organizations, etc.

Some cities use wire incinerators for burning paper rubbish in parks. The cage with a top prevents the paper blowing away, and a match applied reduces it to ashes in a moment.

Under the auspices of the City Improvement Committee of the Akron, Ohio, Chamber of Commerce, a successful yard campaign was carried on. Three prizes of $20, $10 and $5, and four prizes of $2.50 each were given.

Wichita Falls, Texas, offered a prize of $100 for the best kept back yard.

A prize of $25 was offered for the best "Clean-Up and Paint-Up" song in Cincinnati.

Prizes to children range from $2.50 to $5 in gold, with diplomas for honest effort, buttons with suitable inscriptions, badges, etc.

Through tireless energy the Director of Social Centers of the Public Schools in Cincinnati succeeded in having hundreds of school gardens planted. Many of these were planted in vacant lots which had formerly been the abiding place of heaps of rubbish. One was upon what had been for years an objectionable public dump adjacent to the Windsor School. Several loads of dirt were applied to this in the fall and the cost defrayed from the campaign fund.

In September an exhibit of school garden product was held and prizes offered. $25 was appropriated from the campaign fund for this purpose.

Prizes of school equipment to the children making the best showing in the growing of vegetables during the summer were given in Kewanee, Ills.

Fire Prevention and Inspection

Taking into consideration the fact that in 1914 the loss in Philadelphia alone from combustible materials was $300,000, the question of fire prevention is a big factor in the clean-up work, and at least one city, Cincinnati, has laid special emphasis upon safety as well as sightliness and cleanliness—as a result of the clean-up campaign. The efforts of Cincinnati in this direction will bear repeating:

"The success attained in the Cincinnati campaign in 1914 so impressed the State Fire Marshal that he assigned one of his assistants to spend his entire time in the 1915 season going about the state organizing in the different cities clean-up campaigns based upon the Cincinnati plan, and in which inspections by the State Fire Marshal's department played an important part. Since it is estimated that 80 to 90 per cent. of all fires are caused by accumulation of rubbish or trash of some sort, a thorough renovation of all premises in the city must decrease the risk of fire. Therefore the more thorough the Clean-Up Campaign the more work done toward fire prevention. The $600,000 reduction in fire loss, from $1,341,348 in 1913 to $793,796 in 1914, may be traced largely to the result of the Clean-Up movement. This means a reduction of insurance rates in the business district of from 5 to 8 per cent. and an annual saving of perhaps $160,000 in fire insurance premiums."

Inspection

Another distinctive feature of the Cincinnati campaign was that of inspection of the city, which became an important factor. In order to assist in the working out of the system to be used, the State Fire Marshal, with the Chief Inspector, made a special trip to Cincinnati for a conference, and later the General Secretary went to Columbus to examine the system of inspection at the office of the State Fire Marshal. The report card printed below was finally adopted. The inspection was laid out as follows:

1. Inspection in the downtown business district to be made by deputy state fire marshals and members of the State Fire Prevention Association.
2. The rest of the city to be inspected by firemen and policemen.
3. All inspection cards, when turned in by inspectors, to be sent to the office of the Cincinnati Fire Prevention Bureau, where the particular department to which each defect should be referred for correction might be indicated upon the card.
4. The cards then to be sent to the office of the general secretary for (1) tabulation to be made of all defects reported, (2) the department interested in the defect to be notified, (3) copy of the notice to the department to be mailed under two-cent postage to the person responsible for the defect.
5. After re-inspection by the various departments, and correction of the defects, the notices to be returned to the office of the general secretary with a statement in each case as to just what had been done.
6. The general secretary then to tabulate the acts of the various departments, thus making possible to set forth statistics in regard to things accomplished, something that was impossible in 1914.

The improved conditions found in the downtown section in 1915 are reflected in the fact that in both campaigns the Ohio State Fire Prevention Association followed up its work by a bulletin to the fire insurance companies upon which all defects were listed in detail. In 1914 it covered 38 pages, and only 7 pages in 1915, the district inspected being practically the same for both years. This indicates most clearly the improved conditions of 1915, and the effectiveness of the 1914 campaign toward permanently better conditions. When the time for inspection arrived 37 non-resident members of the Ohio State Fire Prevention Association came to Cincinnati and remained for several days. Their services, together with the help of the local members, were invaluable. In 1914 the inspections made by the members of the Association were handled by them alone, but in 1915 all their inspection cards took the regular course. Of the total inspections made in the city (43,424), 61 per cent. were reported free from defects. The Cincinnati Fire Prevention Bureau made inspections in the congested district during the campaign which other inspectors were unable to cover.

(To be continued)

Drainage for Wetness and Drought

The Ontario Agricultural College, Guelph, is sending out notices calling attention to the importance of proper drainage of farms and to the assistance rendered by College, when requested. The following information is taken from one of their circulars:

The great factor in moisture control is drainage, natural or artificial. Few farms are sufficiently drained by natural means. Nearly all require some artificial drainage. The problem then is, "Where shall we place our drains?" "How deep shall we put them?" "What size of tile shall we use?" The position of the drains depends largely on the slope of the field; the depth, on the kind of soil; the size of tile, on the extent drained and the fall or grade given the drain. If any farmers are uncertain about these points or anticipate any difficulties the Ontario Agricultural College will send a drainage surveyor who will, if necessary, prepare a map of the farm showing the location of the drains, the size of tile to use and the grades and depths of the drains. The cost for these services will be the travelling expenses of the surveyor, and as several surveys are made on one trip the charge is seldom over three dollars for each survey. Those who have had their farms surveyed and have installed part or all of their drains may have a new plan prepared free of charge if they will return the old plan after marking in all changes made in the original system. On the same terms as those for surveys, the College will send a man to give any farmer a start on the installation of his drains if he has had no previous experience. He will show how to set grade stakes, grade the ditch bottom, make the junctions of main and lateral, lay the tile and assist in any way required.

If you contemplate draining during 1916 or are planning for 1917 and need assistance write to the Department of Physics, O. A. College, Guelph, or your District Agricultural Office, state your difficulties and request assistance.

Clay Qualities—Testing and Sampling

To Overcome Difficulties in Manufacture and Ascertain the Possibilities of a Profitable Business

By H. B. Henderson*

THE purpose of a laboratory test is to determine the qualities of the clay, the troubles which will have to be overcome in the manufacture of any type of ware, the process best adapted to the material, and the possibilities of a profitable business.

With this end in view, we will give some observations from the experience of a number of years and based on the examination of a wide range of materials coming from practically every state in the Union and a number of foreign countries. During this time we have observed many peculiarities in materials used in the clay-working industries. Such observations as I shall present may not be new to all of you; some, probably, will not be new to any one. But why should we concern ourselves about the new things when it is the same old set of troubles that the clayworker is up against whether his factory is located in the United States, Canada, Argentine or Africa. Therefore, our first observation is: The best way to keep out of trouble is to avoid it. Adopt the principle of preparedness by first finding out the limits of your material, then stay within the boundary.

Physical Defects in Clay

This paper is limited to a discussion of clay testing, but equally important is the clay sampling. We test the clay that is sent to us, but it may or may not fairly represent the working bed of material. The physical properties of the clay affect the working behavior, and the particular difficulty is lamination, the bete noir of many clayworkers. This is a machine trouble but oftentimes it does not show its effect until the drying and then it is attributed to the drying. Frequently it will not develop its harmful effects until the burning, and then the fault is ascribed to the burning. Lamination, in brief, is simply the slippage of the clay on itself, forming planes or "slickensides" in the clay mass. If the clay is a sticky one and of an adhesive character rather than a cohesive, it will stick to the dies, retarding the flow of the clay next to the dies, while the clay within the mass flows ahead. This is die lamination and very common in the manufacture of thin-walled ware, such as fireproofing, drain tile and sewer pipe.

In an auger machine the auger cuts the clay into a spiral, which is packed into and forced through the die. If the clay is lacking in cohesiveness and in binders the layers may not bond together and under the strains of shrinkage in drying and burning they may separate. This is auger lamination, and its seriousness depends upon the degree to which the layers bond together in the burning. Badly laminated ware, such as drain tile in the green state, is simply a series of layers which may be easily peeled off. In the drying, or burning, especially if conducted too rapidly, the outer layer will shrink and crack and curl off, which we call "slabbing."

If the outer layer does not crack and peel off in the burning, it often happens that during freezing weather, after the ware is piled on the yard, the layers are forced off, one by one, and the ware goes to pieces. Ware of larger mass, such as brick, has both die and auger lamination and may be a series of more or less concentric layers from the surface to the center.

The only test for these troubles is a machine test, although often tests are made by simply working up a mass of clay by hand, drying and burning it. Such a test gives some information but misses the difficulties which might arise in machine work. The practical test is to make up ware on a machine, and in the course of this operation determine whether the clay has sufficient strength to stand factory handling, both in the green state and when dry. It is not important to determine the degree of strength; in fact, we have no standard of comparison.

Plasticity

A number of methods have been proposed and devised to determine the degree of plasticity, and while of scientific interest and value, yet they do not meet the requirements of a practical test. They may show the degree of plasticity, each method having a range of its own, but the most plastic or the strongest clay because of lamination difficulty may be the least valuable for clay-working.

The machine operation alone determines one thing the clay-worker wishes to know, namely: That the clay will make good machine ware, and that the ware will be strong enough to stand factory handling. Objections are frequently raised against laboratory tests, but these tests are most important in determining the limits of the material. In this connection, the operator's experience and knowledge of the working qualities and peculiarities of a wide range of different materials becomes most valuable. Only by relating the material under examination with other materials of a similar laboratory behavior and which have later been proven in factory practice, can he form a correct judgment as to the value of the material.

Kaolin or kaolinite is the clay base and is highly refractory. Our pure fire clays are really kaolin, although we do not use this term, but instead call them flint clay, No. 1 and No. 2 plastic fire clay. The melting point of pure kaolin is cone 5 and is lowered with increasing content of other minerals. The most common and predominating mineral associated with the clay base is silica, which is also highly refractory. It sinters about cone 26, but retains its shape above cone 30, perhaps as high as cone 34. Here, then, are two highly refractory minerals, but any mixture of the two is less refractory than either alone. In general, any mixture of refractory minerals will fuse at a lower temperature than the minerals alone.

Silica Clays

Silica plays an important part in clay ware manufacture. We use it to overcome lamination, to reduce plasticity, and to counteract shrinkage. Some highly silicious clays swell in the burning instead of shrinking and the increase in size is due to the mineralogical changes in the silica under heat treatment. These changes in volume within our kiln temperatures may amount to nearly 15 per cent. The condition of the sand, fine or coarse, has material effect on the be-

* Before National Brick Manufacturers' Association, Cleveland.

havior in drying and burning and upon the resulting product. To go into a discussion of the effects in detail would too greatly expand this paper, and it need only be said that in testing the material, consideration must be given to the generally considered inert material sand. Particularly is this true in salt glazed ware, because the glaze is dependent upon the quantity and degree of fineness of the silica.

Feldspar is another common mineral in clay and a more active one than silica, but there are few troubles traceable to it, at least in the more common wares. It is an alkali alumina silicate and is valuable in giving a permanent bond to our burned ware. It fuses from cone 4 to cone 9, depending upon its purity—probably at lower temperatures with other minerals, bringing it within an average kiln temperature for common wares. We count it as a fluxing material and it has the advantage that it acts slowly, thus giving us a safe burning range. It is not necessary to determine the feldspar in making a practical test, except for pottery wares. We are chiefly concerned with the burning behavior and need only look out for those minerals which give trouble in the burning.

Mica is also common in clays, and some clays are largely mica, as, for instance, the micaceous sands of New Jersey, formerly known as "kaolin." Some micaceous kaolins cannot be distinguished by casual examination from kaolin, yet may be 80 to 90 per cent. mica. Its determination is very important in tests for pottery bodies, but of little importance in common clays. It fuses at temperatures above that of ordinary kilns and frequently passes through the fire without any appreciable change. Mica is also an alkali alumina silicate and illustrates the point that chemical analyses, upon which many rely, are of little value. A micaceous clay and a feldspathic clay might have the same ultimate composition and yet behave widely different in the burning.

Popping

Lime minerals are very common and very troublesome. The effect of limestone pebbles is well known. The stone burns to caustic lime at about 1,600 F. and when exposed to atmospheric agencies, hydrates, swells and pops off flakes of the surface of the ware called "popping."

Clays which "pop" after burning in up or down draft kilns, often will not "pop" when burned in a continuous kiln, especially if the kiln has no advanced heating flue. The sulphur gases of the continuous kiln convert the lime into sulphate which does not hydrate. Lime in an extremely fine condition or as a constituent of a mineral which dissociates at kiln temperatures is extremely troublesome in the burning. It does not act as a flux at a low temperature nor until disassociation takes place and then it seems to act suddenly and completely. A clay bed must not always be condemned because of the presence of lime pebbles, some limestone, likely because they are earthy or perhaps dolomitic, do not cause "popping." The shale beds near Buffalo and Toronto, Ont., have intersatisfied streaks of limestone six to twelve inches thick, yet the ware made from this shale does not "pop." The ware may be soft up to a point when the lime begins to act as a flux, then hardens and begins to fuse all within a range of one or two cones. We consider three cones the minimum kiln range in practical work without excessive fuel consumption, but many limey clays will harden and fuse within two cones, even within one cone range and are impractical in commercial kilns.

(To be continued)

Quarrying and Cutting a Granite Block Weighing 225 Tons

What is believed to be the largest piece of granite ever quarried in this country for any particular purpose is the bowl, or basin, of a large fountain on the estate of J. D. Rockefeller at Tarrytown, N. Y., which was cut from a granite block measuring 22 ft. square by 5 ft. 3 ins. thick, weighing approximately 450,000 lbs., taken from the J. J. Goss Corporation's quarries in Maine. The Rockefeller fountain stands 32 ft. high, is 20 ft. 8 ins. across the bowl, and is an exact reproduction of the beautiful La Fontana Del 'Oceano in Florence, Italy. The method of cutting the block is graphically described by Mr. Goss in the American Stone Trade.

"We enjoyed a peculiar advantage in the execution of this contract since the distance from our quarry to tide water in Penobscot bay is but 1,000 feet and down grade all the way. We had a ledge of granite in our quarry 10 feet thick and large enough otherwise to get out the rough block, which was done by putting in a lateral row of plugs and "feathers" clear around the two exposed sides of the sheet at a distance of about five to six feet down from the top ledge. In addition, we drilled three horizontal holes one and one-quarter inches in diameter and six feet deep into both the exposed sides of the ledge directly in line with the plug holes. Blasting powder was exploded in the six deep holes (three on a side) and the rough block was successfully split loose from the main ledge, but with a very uneven bottom.

"By driving iron wedges in the crack split by blasting, the block was raised high enough to take the

lips of various jacks, after which it was moved from its natural bed by iron rollers to a roadway built up for the purpose, when some 70 or more knotty, spruce, wooden rollers about eight feet long and from 10 to 12 inches in diameter were employed to roll the stone about 600 feet to a position on level ground for working. A portable engine securely anchored supplied the propelling power.

"Once in position, the upper or concave side of the bowl was first hewed out, leaving the rim partly finished. Our next step was to turn up the bottom side to which there was yet attached about 100 tons of grout or waste granite that would have to come off. This was done by digging a hole wide enough to take the block in the process of turning 15 feet across the top and 13 feet deep, the end of the stone projecting about four feet over the edge of the excavation. Into this we piled loose dunnage, level full, to cushion the nearly finished rim of the basin which was heavily padded with felt. This rim of the basin had to take the impact of the enormous strain in turning the bottom side up and the basin at the stage must have weighed fully 125 tons, so you will understand that we had to be exceedingly careful.

"When all was ready, the side farthest from the excavation was bridled with the tackle of a 60-ton derrick and, by starting the mass with jacks, the straining cables of the derrick by degrees caused the block to slide ponderously into the hole, pressing down the dunnage about eight feet, and come to rest on the edge of the excavation at an angle of about 45 degrees. From this position it was slowly jacked and pulled to a perpendicular, rising over 20 feet in the air. A pier of railroad ties intended to trip the bowl on its over and downward course had been already built up in the hole to a level with the ground. Loose dunnage mixed with tree saplings to break the shock of the fall were then piled up almost as high as the bowl itself, which was then given a tilt by the cables of the derrick and with a crash came to rest bottom side up for further work.

"All the exposed surface of the bowl had to be honed or rubbed smooth which was accomplished by making a wheel-shaped wooden frame and attaching to it a series of carborundum bricks, one to follow the other and cut to fit the contour of the surface. A six-inch hole had been drilled through the exact center of the basin to admit the water pipes and into this hole was thrust an iron pin, around which the frame revolved like a great wheel driven by the power from a portable engine. After a section of surface or raceway equal to the width of the carborundum bricks was rubbed smooth, a series of new bricks were inserted in the frame overlapping the smooth race-way already made and so on until the work was completed.

"In order to finish the upper or concave side which was now down, it was necessary to turn the bowl back to its first position. This was done by filling the excavation made for the first turn, after which the bowl was rolled back to its original working position. The hole in the ground was again dug out and the second turning of the bowl was accomplished by following the method employed at first when the inner or concave side was completed and rubbed smooth down to the water line by means of the revolving frame which our workmen facetiously dubbed the 'Merry-go-round.'

"When finished, the bowl measured 20 feet and eight inches in diameter, three feet three and three-eighths inches from the top of the rim to the bottom joint with a thickness of one foot and three inches in its center, where the water pipes come through."

A Contractor's Suggestionto Engineers and Building Inspectors

By J. H. Gordon*

DUE consideration of the title of this paper and an adequate study guided by the experience of the average contractor leads us to the conclusion that "suggestions from the contractor to the engineer and inspector" must reach him through the highway commissioner and his immediate deputies in order to be effective. For the policy of the commissioner becomes immediately upon his accession the policy of the rank and file; his opinions, his point of view, his very idiosyncrasies are at once reflected in his subordinates. If he be perchance a believer in brick construction for state highways, the department immediately uncovers a host of advocates, exponents, and experts, for this form of construction; but should he be succeeded by a commissioner who is in favor of bituminous macadam, the erstwhile brick advocates subside and are replaced or join the ranks of the advocate of the bituminous roads. This reflection of policy is carried out even in detail, and if we find one administration with a hobby for nice looking culverts it will leave behind culverts with a finish that would do justice to a household mantel; but should this commissioner retire and his successor be particular about shoulders and slopes we will find the culvert work resuming its proper importance in construction and now we have a modeled and molded shoulder and a mathematically correct slope. This attitude upon the part of the subordinates is very natural and very normal There are, of course, some intrepid spirits, generally among the older and more experienced men, who always bear in mind the fundamental and are respectfully but not unduly impressed by the various hobbies that they are confronted with. We are therefore led, as stated in the beginning, to the inevitable conclusion that if the contractors are to make their position plain and their experience of value and effect they must address themselves to the highway commissioners and their deputies.

Form of Contract

The form of contract in use in most of the states and municipalities is a relic of the dark ages and contains certain stock sentences and paragraphs that are absolutely unfair to the contractor and are never included in contracts between individuals. These clauses seek to make the contractor liable not only for his own mistakes and misfortunes, and the ordinary hazards of construction, but, in unmistakable terms, fasten upon him the liability for the errors, inefficiency, or carelessness of the state's agents and employees.

We find in many of these contracts the clause: "The Contractor further agrees that he will make no claim against the State by reason of estimates, tests,

* Before American Good Roads Conference, Pittsburg.

or representations of any officer or agent of the State." We find further in this same form, that the "contractor assumes all responsibility for damages through the negligence of himself or his agents or employees"—all proper enough, but we find added, "or for any other cause." I might cite further, but from these two quotations it is apparent that there is a one-sidedness to this form which is revolting to every man's sense of justice and fair play. The phrases are old offenders, but it is time they were finally removed. The whole form of contract needs revision; it should be made modern; it should be drawn with due regard to the rights of both parties, and the great states and municipalities should assume for their agents that responsibility which they demand of the contractor for his employees. The inexperienced and timid in office too often take refuge behind these clauses, and the contractor's only recourse is the courts where he has been met before now with the charge of the judge, that having signed a contract carrying these clauses he is liable, however unjust the clauses themselves may be.

Inspection

The inequality in inspection is as marked as it is deplorable and much of it could be eliminated if care were taken to accurately state what is meant and intended.

This care should begin with the preliminary survey which is too often made hurriedly or under adverse weather conditions, and when the actual construction begins the contractor finds that his work is radically different from his idea as derived from the plans and specifications. Final surveys of excavation and embankment at times show as great a discrepancy at 25 per cent., although no great departure has been made from the plans—a result scarcely excusable. The preliminary survey should be made with the utmost care and the plans and specifications drawn therefrom should be the subject of the most careful thought and study, and when finally adopted should not be lightly changed. The location of the material to be used should be definitely and exactly stated and the responsibility for these locations and quality of material should rest with the state. Should these sources of supply be exhausted or deteriorate in quality it should be the state's burden to bear the loss and not, as now in many contracts, the contractor's. No impartial tribunal could rule otherwise.

Quality of Materials

A word here as to the quality of materials: The rise and progress of the testing bureaus has been rapid. Has too much weight been given to their reports? And is it not true that actual results in construction have been disregarded because of conflict, even slight, with theoretical test reports? Has not this insistence on exact compliance with a fractional standard added greatly to the cost of construction without adequate return?

The commissioners of highways would receive much and valuable information by more frequent consultations with intelligent and experienced contractors. No specifications should be drawn without the opinions of contractors being given due consideration, for it is the contractor and not the engineer who builds the road. Look over the records of your departments. You will find that a contractor, Mr. A, has been building good roads for many years, that his roads endure, that the repairs on them are the minimum. You will find that Mr. B, who has been building roads for a like period, has usually poor roads, requiring early and constant repairs, and yet both men were working under the same specifications and under the same engineering force. There is emple evidence to support the claim that the contractor is the one to whom we must look for results and that his judgment and experienced opinion should be given more weight than they have, in most instances, in the past.

The solution of the questions of the disposition and handling of the engineering force, and a proper equal and fair supervision of the work of the contractors is difficult and trying. The complex human equation always confronts us. In the vast volume of work in highway construction it is necessary many times to place young and inexperienced engineers in charge. Their opinion should not be given the weight of the opinion of the experienced engineer as it so often is when in conflict with the contractor. For his own protection the division engineer is apt to place the inexperienced man in charge of the work of the reliable contractor, and the more experienced and diplomatic engineer with the inexperienced and perhaps troublesome contractor, with the result that the good contractor's work is more costly to him, and as a consequence we see today many of the best men being driven from the business.

Organization

The position of commissioner of highways in a great state spending vast sums of money is arduous and trying and I know of few positions more difficult to adequately fill. The highway laws are often loosely and hastily drawn and the commissioner is hedged in with so many restrictions that he is at times almost an automaton. There are few points that I have brought out here that are not in accord with the judgment of the experienced commissioner, but until the laws are changed and he is given more discriminating power he is helpless. Politics have been the bane of road building both from the standpoint of the contractor and the engineer, and yet if the leaders of both great parties will review the past and consider the future they must conclude that as a political asset highway patronage is a boomerang.

In my opinion the ideal highway department would have three commissioners, one engineer, one contractor, and one man of affairs, with terms of office of two, four and six years. This would give a continuity to the policy of the department without making it too inelastic. It would secure the position of the engineering force, it would enable the commissioners to become acquainted with their work and their department, with the engineers under them and the contractors doing business with them. It would give time for the tests of materials and forms of construction. It would develop experts. Politics should be removed. Only under a continuous and stable policy can good and permanent work be done.

In a few short years an organization could be perfected that would be of incalculable benefit to the cause of good roads, and would be a source of pride to the citizens of the commonwealth, for the raw material is there. Taken all in all, as a body the men engaged in the engineering profession are as fine, devoted and conscientious a body of men as adorn any profession or walk of life. And may I say for the contractors that most of them value their reputation highly and are anxious to do good work at a reasonable profit, and only ask from the states and municipalities that fair, equal and proper treatment which they would demand and be granted if contracting with an individual?

Co-operation in the Brick Industry

The need of unity among manufacturers to restore the demand for brick as a building material

By W. B. Wreford*

The brick industry today is probably at the lowest ebb it has known for several years. The demand is light, and many manufacturers, to keep their plants in operation, have cut their prices so much that the price of brick is from $2 to $5 per M. lower than in 1911. The question naturally arises, "What is the matter with the brick industry?" Mr. W. B. Wreford, of Detroit, in a paper before the National Brick Manufacturers' Association in a recent convention at Cleveland, points out the lack of unity in the brick industry, and the necessity of working together in order to restore the demand for brick as building material.

What's the matter with the brick industry? The daddy of all building material is in excellent health, but if you took an able seaman, fireman, engineer or any other human being with a trade and told him that he must set back absolutely and not complain, whether you gave him anything to do or not, he would fret himself into an illness. The same thing can be done with an industry, for industry is life itself. There is an old saying, "you cannot make money without spending it." There never was a truer axiom written. Trade conditions have proven it over and over again.

I do not think any one man in the country could tell "what's the matter with the brick business." Each of us can tell what has happened to it in the particular locality in which we are working, each of us can point to instances of success here or there, caused by certain circumstances, peculiar to that locality. We go, however, into the realm of theory when we say that the principles applied anywhere will produce the same results.

While a man may talk pleasantly upon theories, he talks convincingly only upon such subjects as he has touched with his hand or seen with his eye. Therefore, I am going to endeavor to deliver a message which I hope will be more convincing than pleasant, and confine myself to organization work.

I once rode on the front seat of a stage-coach with a typical old driver, who amused me for some time killing bees by the snap of his whip. I watched him kill over a dozen in as many tries; finally, I spotted a bee-hive with at least twenty-five bees around it and asked him if he could kill them; his reply was: "Nothing doing, lad, them's organized." The story very clearly illustrates the position of the brick manufacturers. This is not a new condition nor a new statement, but stands out so clearly as a fact that it bears repetition.

I would like to see every building brick manufacturer, big or little, materially assist toward the making of a national campaign for brick. Ask any paving brick manufacturer if he would like to see the National Paving Brick Manufacturers' Association die.

About six months ago, following out a resolution passed at the last convention of the National Brick Manufacturers' Association, a group of brick manufacturers met at Indianapolis, organized and incorporated the National Building Brick Bureau, and elected officers.

* Before the National Brick Manufacturers Association, Cleveland.

Notification was sent out to all brick manufacturers, memberships and subscriptions solicited. Up to date something less than $5,000 has been subscribed.

The main idea underlying the formation of the Building Brick Bureau is to make of it a power station and clearing house for the development of local advertising and publicity all through the country.

The bureau has a three-fold task mapped out for itself in this connection and others can be added from time to time. The three primary lines of activity are to encourage advertising on the part of the brick manufacturers, to assist in preparing advertising matter and directing the lines of exploitation work, and to collect and furnish specific data for its members that will be of value in the promotion of brick as a building material against all competitors.

The bureau is organized along proper lines and has no intention of going into a wild campaign of money spending, but proposes, by systematic effort, to place before the building public facts, figures and selling talks to aid the sale of brick. One of the first services of the bureau is the publication of a booklet, entitled "Distinctive Brick Homes." If money enough can be raised, the booklet will be placed in the hands of every architect, builder and contractor in the United States. If you will secure a copy of the booklet, you will see in a moment the advantage such a campaign would have. It takes money to do this, which means that every brick manufacturer should contribute something, a $50 or $100 check would help, though it is not enough to gain the actual results desired.

You all know how thoroughly the cement industry is organized. Annually they expend in their publicity campaign twelve millions of dollars, which, as they say, represents but a fraction of a cent of each dollar's worth of business done. The market value of material has gone steadily upward, yet the market value of cement, as shown in the following table, never reached the market value of brick in any one of the given years:

	Amount Manufactured.	Market Value.
—Year 1912—		
Brick	11,194,795,000	$ 91,303,448
Cement	85,925,651 bbls.	69,554,385
Lumber	39,158,414,000 ft.	601,081,645
—Year 1913—		
Brick	10,892,434,000	$ 93,849,649
Cement	89,541,348 bbls.	89,550,527
Lumber	38,387,009,000 ft.	589,142,588
—Year 1914—		
Brick	9,704,874,000	$ 83,187,045
Cement	87,257,552 bbls.	80,553,203
Lumber	37,887,142,000 ft.	*580,557,629

*Estimated.

Still they have an organized publicity fund of twelve millions of dollars, which does not represent the money spent by the individual firms for advertising purposes. Then take the lumber industry which spends annually $50,000 through its National Lumber Manufacturers Association, and is after more money and unquestionably they will get it. They have the jump on the brick manufacturers, and while $50,000 is not such a big jump when all the brick manufacturers in the United States are considered, it's a lead that must be overcome. The ever present reason that brick men must organize is the fact that brick is sold in communities, especially common brick, whereas the cement and lumber interests have the entire country for their market. This fact alone makes it especially vital that the brick interests should organize for publicity and advertising purposes. Just stop to think what a wonderful assistance a semi-monthly magazine published by the National Building Brick Bureau would be to you, containing suggestions for advertising and publicity copy. It would not be expensive and if a start were made by all brick manufacturers agreeing on an assessment, for organization purposes, of one-half cent per thousand on all brick manufactured it would stimulate the brick market to a degree almost unbelievable. However, there can be no half way station. No small group of brick manufacturers can make a success of such an undertaking. One and all must realize its importance. It is simply a case of "United we stand, divided we fall."

You will say that what I have already stated can be done in one community necessarily cannot be done in others. However, there are thousands of things that can be worked out for the brick manufacturer, no matter in what section of the country he might be in. No effort need be made to tell you how to run your business, but suggestions could be offered that would materially assist the individual manufacturer.

Here, for instance, is a sample of what one of the big cement concerns are doing. The letter which I am about to read has been received by every live architect in the United States.

New York, N.Y., January 3, 1916.

My Dear Sir:

Beginning January, 1916, an unusual and, we believe, a significant series of our advertisements will appear in the journals of the architectural profession. They will deal with the merits of reinforced concrete for industrial buildings. And also for the first time they will extend to architects the services of our Reinforced Concrete Engineering Department.

The function of this department is to furnish such data as architects may require for their consideration of reinforced concrete, and to lend such aid as may be desired for preparing designs in which the reinforcement is completely detailed. This service is free.

Simultaneously there will appear a series of advertisements to prospective owners in the standard magazines, directing their attention to the merits of reinforced concrete for industrial buildings. They will not recommend reinforced concrete indiscriminately for buildings not suited to its use. They will emphasize the advantages for certain kinds of industrial buildings. They will tell owners that it is permanent, fireproof, economical, sanitary and that it carries the lowest insurance rates.

The result of this we hope to make the owner see the wisdom of permanent construction, so that he may be the better prepared to receive his architect's recommendations.

The object of this entire campaign is obviously to increase the legitimate use of cement. We naturally want you to use Atlas, but the whole purpose of this letter will be missed, and our project itself not understood, if you are left with the impression that in order to obtain the services of our Engineering Department you must use Atlas. We can well afford to be satisfied with our share of the increased business that should result.

Yours very truly,
The Atlas Portland Cement Co.,
John R. Morron, Pres.

Just think at what a little cost could be maintained a brick bureau for the disseminating of ideas to architects concerning brick.

With your indulgence I am going to tell you what has been done through a local organization in Detroit, known as The Detroit Brick Manufacturers and Dealers Association, operating since a year ago last September. Partly as the result of the work of this association it is necessary for every brick plant in Detroit to work full force all winter in order to prepare for the present demand and the rush of the spring building season. There is nothing very difficult about the work of the association. Here are a few of the lines of endeavor that are being followed:

During the first year they paid for 1,000 inches of newspaper advertising and as the result of this they had 2,000 inches free publicity published. Let me call your attention to the fact that names of brick manufacturers are not used in any of the copy.

They also have a building sign, a card 22x28 inches, which is placed on every brick building under construction. These signs cost $2.80 per hundred. Then there is the road sign. These signs are placed on all roads leading into Detroit with the arrow pointing toward Detroit. These signs are 14x22 inches and cost $2.00 per hundred.

The wagon sign is used on all wagons that haul brick. They cost $5.00 per hundred.

The back of the Detroit building code carries the Build with Brick advertisement. The cost is $3.00 per year, 5,000 copies being printed by the publishers.

Our test booklet, known as "Practical Tests," contains facts pertaining to brick and hollow tile construction. These tests were conducted under the supervision of Professor F. N. Menefee, in charge of the Materials Testing Laboratory at the University of Michigan. These tests cost about $3,200, a copy of the booklet has been supplied to all architects, contractors and builders in the city of Detroit.

Space has been retained at the Builders and Traders Exchange permanent exhibit at a monthly cost of $35. An architect is now at work drawing plans for a miniature brick house to build of miniature common brick. The size of this space is 10 feet by 11 feet.

Last, but not least, the booklet supplied by the National Brick Bureau. This booklet contains information relative to the history of the brick making industry, in addition to the twelve designs for brick homes. These designs were selected from among the ones that were submitted to the Indianapolis Star during its recent competition for the best drawings for brick homes to cost not over $7,500. All Detroit architects and contractors have been supplied with a copy.

This gives a general outline of our activities in Detroit, which you see is simple publicity and advertising work that can be successfully handled in any community.

Summing up, what answer do we get to "What's the Matter with the Brick Business?" As I see it the answer is, "Be Alive." Make them talk brick and they will buy and use it.

The last word I have to say is on the everlasting question of price. My suggestion along this line is to create a demand and the price will take care of itself.

The Design of Modern Power House Foundations and Footings

By J. N. Hatch*

IN the early uses of electricity before long-distance transmission of energy had developed, the amount of power required from any one station was small. Therefore the requirements in the way of buildings for housing the generating machinery were simple. Today, however, with the centralization of power in large units, the problem of working out a proper design for the building and foundations has become an important branch of engineering.

The layout of the machinery is the fundamental determination in planning a power station, but if this is made arbitrarily without any special reference to the building design, it often becomes difficult, if not impossible, to design a neat well-balanced building to inclose the machinery. For any power-station design it is desirable that the mechanical, electrical and building engineers work closely together so that the machinery and the electrical layout can be arranged with some reference to the building features. To accomplish this it is generally necessary to make a number of preliminary studies and then by a process of elimination and rectification work out a design that will best serve the end of all. As soon as a design that will determine the main features of the building is tentatively decided upon, the work of the real design of the building can be started.

Site

One of the first things to be decided is the kind of foundations that will be required. The site for a power station may be on the lake shore, where the high waves and shifting sands make a problem of one nature; or on salt water, where the corrosive conditions are severe; or on the bank of a river, where the rise and fall of the stream between extreme high and low water is 60 or 70 ft.; or it may be along a river where the quicksands are extremely treacherous, or along a river where the foundations will be on solid rock. If the site of the proposed building is in a city or town, it is often possible to gain considerable knowledge from the investigation of structures that have been built in the vicinity and from an inquiry of the nature and character of the underlying soil. But it often happens that a power station is built far away from any other building and the engineer in charge must make all preliminary determinations from his own investigations.

Generally it is necessary to have a number of borings made, and in addition it is often advisable to have a few test holes dug down as deep as the earth can be conveniently excavated. These test holes will afford a means of examining the nature of the different strata of earth. From this examination a good idea can be obtained of what loads the earth will safely bear per square foot. Whether the foundation is simply to rest upon the earth or must have piles or caissons is a matter to be decided by the building engineer from his investigation of the soil and surroundings.

It is generally necessary to bring a large intake and discharge tunnel into the center of the building. This complicates the foundation problem. If the underlying material is solid rock, the tunnel can be driven through it, but if it is sand and gravel to an indefinite depth, the problem is much more difficult, particularly if the tunnel must be sunk to a depth of 50 or 60 ft. so that it will always be below the low-water level of the river on which the station is located.

Foundation Materials

Next to solid rock, sand and gravel are about the best materials upon which to place a foundation for a heavy building, but they must be confined and must not be undermined by deeper foundations near-by. Clay is always a treacherous substance on which to place a heavy foundation, especially if it is subject to alternate saturation and extreme dryness. It is difficult to judge of the load that clay will safely bear, as it seems that almost any clay is subject to some compression, which, although taking place slowly, may continue for many years and become a significant amount in time.

If, upon an examination of the site, the engineer thinks that the underlying materials will not carry the building safely, he must resort to some method of increasing its bearing power sufficiently to make it safe. If there is a hard underlying stratum at a reasonable depth, it may be determined to drive piles, but if the underlying materials do not become solid until a depth of 80 or 100 ft. is reached, so that piles cannot be utilized, it may be desirable to use so-called caissons. These are made by digging wells 5 to 8 ft. in diameter to a solid footing, and then filling with concrete and distributing all loads to them.

If a heavy building is to be placed on soil of a quicksand nature where piles would not be practicable, a method considerably used is to place the entire structure on a reinforced-concrete mat, generally 5 or 6 ft. thick and thoroughly reinforced in both directions, both top and bottom, in the hope that if there is settlement it will be so uniform over the entire building as not to be noticeable. One serious difficulty with the arrangement is to know what is going to happen where the tunnel joins the mat. If the entire mat settles considerably, it is likely to break away from the tunnel where the two join.

It is clear that the determination of the style of foundation best adapted for any particular location is a problem of itself and must be solved for that particular site and the particular building which is required.

Design of Foundations

As soon as the general arrangement of the machinery has been decided upon and a skeleton plan and cross-section of the building has been worked out and the elevation of the exterior has been tentatively fixed upon, the detailed location of all walls, piers and columns must be decided, so that the foundation walls and footings can be designed. A fairly close estimate can be made of thicknesses of walls, sizes of piers and outside dimensions of columns just from a study of the skeleton of the building, and a fairly close approximation can be made of what the weight of the machinery will be from the weights of similar machinery used elsewhere. It is therefore possible to figure the load from the roof downward that will be transferred to the walls and columns and piers. A careful schedule

* Before Western Society of Engineers.

should be made of these loads, showing at what elevation they come and what each is from. These should be put on an outline plan of the building and on a cross-section, so that they can be readily checked over and so that if, after more data are received, there are changes required, it will be easily seen how the original assumption will be affected. This loading schedule will be referred to until the building is completed, and should be carefully made and checked. With the schedule completed, the design of the foundation can be undertaken.

Foundation walls and footings for buildings and machinery are made at present almost without exception of concrete. If below the high-water level the basement floor must be carefully built and joined to the walls so that there will be no leakage.

In the modern large station the smoke-stack is frequently carried on a steel structure over the boilers. This has a number of advantages—it permits a saving in land and in the size of the building and allows one uninterrupted row of boilers. The argument against this arrangement is its extra cost. In some the stack structure is joined rigidly to the building structure and in others it is not connected in any direct way to the building.

Power-Plant Chimney Foundations

Stacks and chimneys that rest directly on the earth do not involve any special features that need to be dwelt upon. It is necessary to remember that under the maximum wind conditions the earth pressure at the toe of the foundation on the leeward side of the chimney may become as much as twice the average earth pressure over the entire base with no wind blowing. Care must be taken to insure there being no uplift under the toe of the foundation on the windward side.

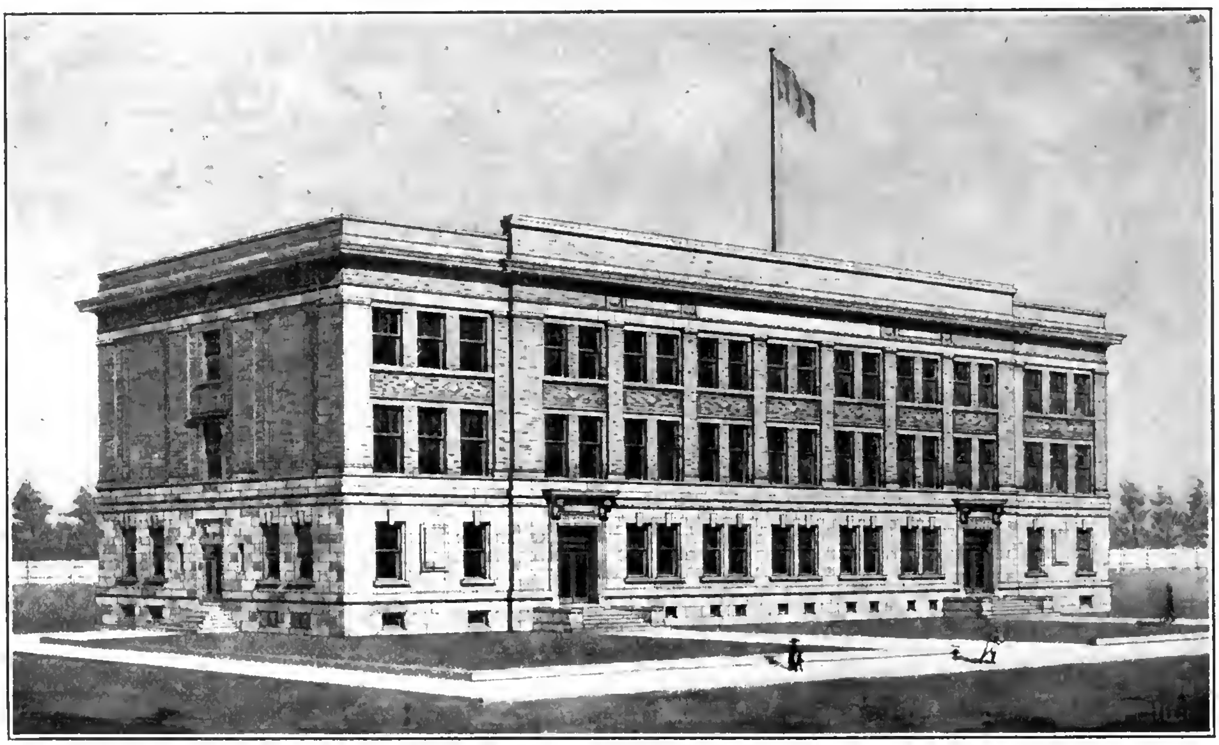
While the purely architectural features should be given careful study and the whole design of the station should be made with the architectural scheme in view, still the usefulness of economy of the plant should not be appreciably hampered to carry through some preconceived scheme. In fact, this is not necessary, for a building of good appearance can be worked out in harmony with almost any well-planned machinery layout, especially if the two are worked out together.

Work Started on Papineau Roman Catholic School at Montreal, P.Q.

On instructions of the Roman Catholic School Commissioners, Montreal, Messrs. Marchand and Keroack and Messrs. Doucet and Morrissette have drawn up plans for a new boys' school, to be constructed on a site on Papineau Avenue and Lafontaine and Lalonde Streets, Montreal. The general contract has been let to Laurier & Rondeau, Montreal.

The total site is 365 feet long and 157 deep, this including a large playground at the Lalonde Street end. The dimensions of the building are 65 feet by 164 feet, the area being about 22,000 square feet. The structure is to be set back 30 feet from the main frontage on Papineau Avenue, there being the same amount of free land at the rear, forming another play ground.

The building will consist of a basement and three stories. The foundations are to be of concrete, with



Architect's perspective of Papineau School, Montreal, P. Q.

a granite base, and grey canyon sand stone to the first floor. From here the exterior will be of Kittanning brick, sandstone trimmings and terra cotta cornices.

There are to be six entrances, the two main ones on Papineau Avenue, one each on Lalonde and Lafontaine Streets, and two at the rear of the school. The stairways will be constructed of slate for the steps and landings with cast iron risers.

The basement will contain a storage room, coal bin and equipment for heating and ventilation, including a boiler for the hot water system.

The plans show a large recreation in the centre of the ground floor with toilet adjoining; on one side are to be the caretaker's quarters and store room, and on other administration offices. The floors on the recreation room and in the toilet will be of ceramic tile, while in the caretaker's quarters and the offices they will be of concrete slab covered with hardwood. Throughout the building there are to be suspended ceilings on metal lath. Terra cotta will be used for all interior wall linings.

The next two floors will give accommodation for instruction. Each floor will contain seven class rooms, with a cloak room adjoining each class room. There will also be toilets, and on the first floor a teachers' room is to be provided. On the second floor a stenographers' room takes the place of the teachers' room. The class rooms are to be divided by a main corridor ten feet wide running the entire length of the building. The rooms are finished in chestnut, while the floors of the corridor and of the rooms are to be of maple. Ceramic tile will be used for the floors of the various toilets. The class rooms will be reached from the main entrance by two wide staircases.

The roof is to be of tar and gravel. A fire escape with iron stairways, will be provided on the Lalonde Street side of the school. The building, it will be noticed, is to be exceptionally well lighted as the site, being open on four sides, gives facilities for the provision of a large number of windows.

How to Build Good Roads at Lowest Cost for Modern Traffic

By F. E. Everett*

IN these days of modern road building, when large sums of money are being expended for highway improvement, when any sort of so-called permanent type of pavement will cost from $10,000 to $30,000 per mile, many engineers and commissioners are brought face to face with the question of how the mileage necessary to complete their highway system can be built without bankrupting the state or county which they represent.

There is no doubt that the high class types of road are most essential and necessary on trunk lines or main roads between cities or county seats, that are subjected to all sorts of traffic from horse-drawn vehicles to motor trucks. But, outside of these main arteries, is it not necessary that a cheaper type of road be constructed? Even if a commonwealth can arrange a bond issue ample to construct its whole system of bituminous macadam, concrete or brick pavement, is it not economy for it to construct a less expensive road? I say emphatically, yes.

With our present completed system the tourist can reach the mountains by any one of three routes and return by either of the other two, but had we been obliged to confine ourselves to a high class type of construction, we could have made but a poor showing on any one of these routes, to say nothing of building three. In the building of these three lines we have resorted to the material we had at hand. In a good many localities there are deposits of good gravel and where this occurs it has been comparatively easy to get good results. In numerous other places gravel could not be found or if found it was of an inferior quality lacking in some important feature, perhaps in binding material, perhaps as is more often the case, in metal.

Under these conditions we resort to a combination of material to get the desired effect. If the gravel is sandy, with no binding material we alternate the layers of gravel with clay or marl or sometimes mix the two materials thoroughly by harrowing or some such other method. If there is not enough metal we have found that with a stone foundation, material of a very inferior quality can be used for surfacing and with very satisfactory results.

We have in New Hampshire a mixture of clay and sand and gravel called hardpan. This is probably more common than any other native material. This material mixed with sand or sandy gravel or even laid directly on the stone foundation or telford is quite satisfactory under our system of maintenance.

Construction

In construction we pay due attention to the essentials—alignment, grading, drainage and foundation. In connection with the alignment it may not be out of place to say just a word as to our methods of survey. Contrary to the general practice adopted by most states, we do not make a plan of the road first and then plot the new road on paper.

The first procedure is to establish the center line of the new road on the ground, correcting the old alignment where possible. With this as a base line we are enabled to stake out the new layout and also make a survey of the existing conditions. Stakes are set every 50 ft. on an offset from the center line. When the cross sections are taken an elevation is obtained of the top of these offset stakes so that when the finished grade is obtained it is easy to determine the cut or fill from the top of these stakes.

If for any reason it is desired to change the alignment after the survey is plotted on the plan, the stakes are on the ground and it is an easy matter to figure the offset either way from them. I believe this method of survey and staking out saves the expense of one engineering operation in the field.

The essentials of drainage and foundation, we give particular attention to, for with these gravel or dirt roads it is very necessary that the water be thoroughly taken care of. A great many of our roads have the telford foundation, especially if the gravel is of an in-

*State Highway Commissioner of New Hampshire, before American Good Roads Conference, Pittsburgh.

ferior quality with a tendency to be heavy or sticky in wet weather.

We have built most of our roads 21 ft. wide from ditch to ditch. No doubt many of you will say that this is not wide enough. In some cases I am inclined to think so myself. However, they have answered very well for the traffic they are subjected to. Our original specifications called for 15 ft. of metal and 3-ft. dirt shoulders. The gravel was laid in three courses of sufficient thickness to make the whole compacted mass 8 ins.

Today we believe that we can get better results by sub-grading the entire width of 21 ft. in practically a flat section. If, however, the stone foundation is used we crown it slightly. On this section the surfacing material is placed in two courses, using a dumping board or dumping the loads in such a way that all the material will be handled over.

We desire to roll each layer, using in most cases a horse-drawn corrugated roller. Some of the larger towns, however, use a steam roller and some of the smaller ones have no roller and depend on the traffic to do the compacting, keeping it in shape by dragging and raking. Of course we get results quicker where we are able to use a sprinkler and thoroughly wet down the separate layers, but in most cases we have to depend upon nature for the wetting. The finished section has a thickness of metal of about 10 ins. in the center and practically nothing on the edges. This gives a crown to the road of about 1 in. per ft., which we believe is necessary for roads of this nature.

We have built in the ten years that the department has been in existence, 1,171 miles of road of which 558 is trunk line, outside of the compact portion of towns having a population of over 2,500. Of this latter amount 422 miles are of gravel construction and represent an expenditure of $1,614,503, or an average per mile of $3,826.

Maintenance

After any road has been properly rolled and the surface has been made compact and smooth, it is desirable that it should always be maintained in that condition. It is a common rule that the finest roads are the result of good construction and system of maintenance whereby every defect is corrected before it has time to cause serious damage. This rule is chiefly applicable to a gravel road for the very obvious reason that if we are to build gravel roads and expect them to give their users the same satisfaction that the more expensive types would give, we must maintain as near a true section as is possible, free from ruts and holes.

The question next arises what kind of maintenance will accomplish this result. As we all know there are two general forms of maintenance, which may be called continuous maintenance and periodical repairs.

It is not my purpose to analyze the merits or defects of these systems. Both have their advocates and critics and both their strong and logical argument. Personally, I feel that both systems are correct. The type of road to which they are applied should regulate their selection. It would certainly be a waste of money to employ constant maintenance upon a high class pavement which we have every reason to expect will wear uniformly until such time as to need resurfacing. On the other hand it would be poor policy to let a gravel road go until it needed resurfacing.

It is important that every rut and hole be filled as soon as they appear for they will hold water which will soften the gravel bed and cause the road to wear rapidly.

The question now arises: What is the best method to adopt to accomplish this continuous maintenance? There could be only one answer to this so far as the gravel road is concerned, namely the patrol system. A patrolman equipped with a one-horse hitch, shovel, rake and drag, etc., given a mile of road per diem, will find plenty to do. A gravel road to insure the maintenance of its cross section should be dragged after every rain. Under the periodic system we could not do this as it was impossible to have the maintenance gang at the proper places at the proper times.

Dragging

As we all know, a gravel road can be too wet or too dry to drag. In other words there is a certain time after a rain when the road is in the best possible condition to work and obtain results. The patrolman constantly on the road is going to know just when this time arrives. He is going to discover the weak places. He will see the small hole when it starts and before it has developed into a large one or a series of small ones. He can patch the roads in the early stages of disintegration without serious trouble or excessive cost.

Theoretically, if a patrolman gives his gravel road proper attention it should never need resurfacing. He will cart on and distribute enough new gravel to take the place of that which has been worn out under traffic. The patrolman fully illustrates that old adage, "A stitch in time saves nine."

As an illustration of the favor in which we hold the patrolman's services, I will cite the increase that has been made in this branch of our organization. In the year 1911 there were two men employed as patrolmen on one of our trunk lines for about two months. This was our first attempt with the patrol system. We have already appointed, for the year 1916, 225 patrolmen. These men will be employed from April 1, or sooner if the weather conditions permit, until December 1. Their average pay will be $3.25 per day. Now arises the question: How much money can be justifiably expended in the maintenance of a gravel road?

Assuming the cost of a modern country road pavement of the so-called permanent type at $15,000 a mile (conservative) and supposing this to be paid for by 20-year bonds at 4½ per cent., the annual charges for interest on and redemption of the bonds amount to about $1,150 per annum. It is safe to assume that even the most permanent type of country road pavement will require repairs and maintenance of at least $50 per mile per year, or in round figures we have a minimum of $1,200 per mile per year as the cost of the improved road.

Assuming that a good gravel road may be built for $4,000 per mile (which we have shown is more than the average cost of New Hampshire roads), the annual charges for interest on and redemption of bonds (if the roads are built by bond issues) at the end of 20 years would amount to about $310. Therefore, it is theoretically economical to spend nearly $900 per mile per year for the maintenance of gravel roads, if for that sum the roads can be maintained in a condition equal to a pavement in the $15,000-a-mile class.

Our claim is, that in New Hampshire, we are able to maintain this condition on four-fifths of our roads. This four-fifths carries an average traffic of about 300 to 600 vehicles, mostly motors, per day during the vacation season.

From the comparison just cited, we find that we can economically spend $900 per mile per year for maintenance. Under the patrol system we do not find this expenditure necessary. Taking forty towns in New Hampshire whose state roads have been built of gravel and maintained by the patrol system, we find that in the year 1915 our average cost of maintenance per mile was $240. This cost includes in some cases the surface application of a light asphalt or non-asphaltic oil. I will leave it to your judgment if this type of road is not the most economical for moderate traffic.

A doubt will probably exist in the minds of some when they take into consideration the amount of traffic that these roads carry and compare it with some of the elaborately worked out theories as to the wearing qualities of plain gravel roads, but we have the experience of several years of this type of maintenance and construction as a refutation.

In fact any of these gravel or so-called combination roads, which were originally built of necessity, have worn so satisfactorily that today we are advocating this sort of construction as a principle. We believe that for four-fifth of our trunk line roads this type of construction is absolutely satisfactory for moderate traffic, if properly maintained, and by far the most economical road to build.

Completed Reinforced Concrete Girder Causeway at Corpus Christi, Texas

Nueces County, Texas, have completed, at a cost of $166,500, a causeway, 8,700 ft. long connecting the city of Corpus Christi with San Patricio County across the Corpus Christi Bay. The following details of the work are taken from Engineering Record. The causeway forms an important link in the system of roads connecting San Antonio with a number of resorts on the Texas Gulf coast.

The construction adopted consists of 6,200 ft. of protected fill, and 2,532 ft. of short reinforced concrete spans, providing sufficient waterway for the passage of high waters and floods of the Nueces River. It also includes a small bascule bridge with a 32-ft. clearance.

The bridge portion, consisting of 76 reinforced concrete girder spans, with 30-ft. clear openings, and the draw span were placed at the south end where the deepest water existed, and provides a total waterway at high tide of 8,600 square feet. The piers consist of a bent, creosoted long-leaf pine piling, 24 lbs. treatment, with a concrete cap 2½ ft. wide, extending down to the existing bottom. The top of the piers is an elevation of 3 ft. above low-water datum. The concrete was placed in the water with a tremie. Piers are reinforced with four rods, two on each side on the row of pile heads, to avoid danger of cracking opposite the piles.

The piles vary in length up to a maximum of 55 ft. They were driven to a penetration of ½ in. under a 6,800 lb. gravity-drop, steam hammer, striking sixty blows per minute.

Reinforced-Concrete Girders

The spans are composed of four reinforced-concrete girders 32 ½ ft. center to center and 30-ft. clear span. The bottoms of the outer girders are in elliptical arch form, and the inside girders are corbelled. The girders and the concrete floor slab were run continuously through five spans; at every fifth pier the entire superstructure was completely cut by a contraction joint.

The roadway is 19 ft. 10 ins. wide between concrete railings of ornamental type, top of floor slab being 9 ft. above low-water datum. Provision for continuity in both floor slab and girders is made by bending up reinforcement.

The roadway is drained by cast-iron gratings and scuppers through the curb. A wiring conduit and anchor bolts were provided for future installation of light brackets over alternate piers.

Concrete and Form Work

The concrete was composed of washed crystalline limestone gravel 1:2:4 mix, and was reinforced by deformed square rods of medium grade structural steel.

Corpus Christi Causeway—76 - 30 ft. concrete spans with 32 ft. Bascule Bridge.

A field testing laboratory was maintained throughout the work. Tests of 4-in. cubes of concrete for girders and floor showed an average strength of 2,800 lb. per square inch at 30 days.

Placing Paneled Knockdown Forms

The forms for the spans were carried without falsework upon eight lines of 10 x 20-in. timbers 32 ft. long resting on the piers in pairs on either side of the four girders. The forms were composed of dressed lumber screwed together in panels and oiled. The panels were supported on the aforesaid timbers and held in position by a system of knockdown framing requiring no nailing, and wired only for the outer girder sides. The forms were used eight times with very little reworking.

The drawspan is of the Strauss bascule lift type. The girders have a span of 42 ft. from center of main trunnion to bearing of moving leaf, and provide a clear span between fenders of 32 ft. The floor is a 4-in. slab of reinforced concrete carried on steel floorbeams and stringers and with 2 in. of trap-rock granolithic for the wearing surface.

Oyster Shell Approach Fills

The approach fills, 200 ft. long at the south end and 6,000 ft. at the north end, are composed entirely of oyster shell dredged from the shell reef which underlies the greater portion of the entire structure. The top width is 40 ft. and the side slopes 6 to 1, making a base of approximately 120 ft. width. A berm of 100 ft. was left between the toe of the slope and the dredge pits. The fill was dredged in to elevation 6.00 above low water and subsequently crowned to elevation 6.50 for the roadway.

The fill is protected by very shallow water on the west side; by a bar and by comparatively shoal water on the outer or eastern side fronting on Corpus Christi Bay. The anticipated shoaling action due to stoppage of cross currents as above mentioned has already developed to a noticeable extent. Although the fill is 30 miles inland from the Gulf of Mexico and is exposed to no severe storm nor wave action, it was thought best to supplement the protection from natural conditions by the following construction precautions: First, the use of oyster shell for building the entire fill; second, the adoption of very flat side slopes comparable to the slopes of the adjacent sand beaches; and third, by the use of brush faggots and riprap to protect the toes of the fill.

Brush Faggots and Riprap

The faggots consist of bundles of mesquite brush somewhat over 8 ft. long and 12 in. in diameter bound securely and tightly by four wire stays. These faggots were placed at right angles to the center line with brushy ends out and in continuous rows, simultaneously with the placing of the fill. Two rows of faggots were placed on the outer side and one on the inner side, except near the abutments, where three and two rows respectively were used. The fill, and especially the finer particles of shell, settled into the crevices of the faggots to form a solid toe. On top of the other slope as thus constructed was placed the riprap composed of 50 per cent. one man and 50 per cent. two man stone placed by hand in an apron one layer thick and 14 ft. wide. The heavier rocks were placed at the foot of the slope. Eighteen thousand faggots and 2,600 tons of riprap were used.

The abutments and bulkhead wings protecting the ends of the fills at the junction with the bridge are of concrete extending down to the existing bottom and resting on creosoted bearing piles and a line of 6 x 12 in. creosoted sheet piles forming a continuous bulkhead.

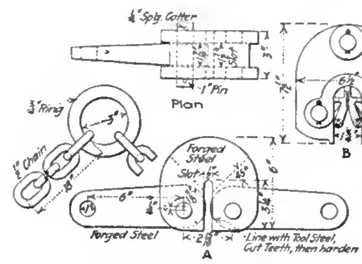
Road Surface and Approach

The road surfacing over the concrete slab is composed of a mat course of tarviated trap rock, and the surface of the shell fill after it becomes thoroughly compacted by traffic will be treated likewise. All materials for the construction of the bridge had to be imported from distances in excess of 125 miles. The Causeway was constructed by W. L. Pearson & Co., Houston, Texas.

Clamps for Pulling Steel Piles

In pulling steel sheet piling the use of a hook in a hole in the pile is not always effective, as the hook may tear through the metal without loosening the pile. Two forms of clamps designed to give a sure grip on the pile are shown herewith.

In the design shown at A the web of the pile is gripped between the eccentric cams formed by the ends of two levers journaled in a heavy steel forging. A chain sling is attached to the outer ends of the levers;



and as the pulling strain is applied to the sling, the serrated faces of the cams grip the web between them In the second design B the arrangement is more compact. The two jaws, or grips, are carried by arms pivoted in the horseshoe frame, so that the downward pull on the jaws (due to the resistance of the pile) tends to draw the arms inward, thus forcing the jaws together.

Slate is generally quarried on the gallery system, that is to say, terraces are cut out of the hillside at regular intervals one above the other, each terrace forming a vantage ground from which the adjacent rock-face may be worked. The terraces are connected by inclined planes, up and down which the slates and quarry debris are hauled in small trucks by means of winding gear. Where a large amount of worthless rock overlies the slate, the latter is often more economically obtained by running galleries into the valuable bed, the workings being thus underground.

Road surfacing, as distinguished from applications of oil for dust laying, is covered in principle and practice in a booklet, Trinidad Liquid Asphalt, just issued by The Barber Asphalt Paving Company (Philadelphia). The essentials of successful "carpet coating" with asphaltic materials are fully explained. As illustrations the pamphlet contains photos of park drives, city boulevards, suburban streets and country roads resurfaced with liquid asphalt by both hot and cold applications. Full specifications, in the form of explicit directions for the laying of carpet coats, are included.

Personal

Mr. R. H. Lee has been appointed city engineer of Kamloops, B. C.

Mr. John Pender West, a Winnipeg architect, has enlisted as a private in the 44th Canadian Battalion. He has been recommended for a commission.

The city council of Fredericton, N. B., have offered the position of city engineer to Mr. George McKnight, an ex-alderman. Mr. McKnight is engaged at present as an engineer with the St. John and Quebec Railway Company, having been engaged in the construction work on the St. John Valley Railway from the commencement of that project.

Obituary

Mr. Henry Hartung, a well-known sewer contractor, of Hamilton, Ont., died on April 2 at the age of 51 years.

Mr. George Smith, engineer, Lindsay, Ont., died suddenly while on a visit to Toronto. He was sixty years of age.

Mr. W. D. Baillarge, chief engineer of the city of Quebec, has suffered a sad bereavement in the loss of his wife, who died on April 5. Mrs. Baillarge was a sister of the Hon. L. A. Taschereau, Minister of Public Works for Quebec.

Mr. W. E. Mann, a civil engineer, and formerly divisional engineer for the Grand Trunk Pacific Railway, Edmonton, Alta., died on March 31st as the result of a fourteen-foot fall to the bottom of an elevator shaft in the Alberta Hotel, Edmonton. He was about 45 years of age, and unmarried.

Mr. H. N. Dancy, a member of the firm of H. N. Dancy & Sons, masonry builders and contractors, Toronto, died on the 4th inst., at the age of 70. Mr. Dancy was associated with many important buildings in Toronto, among them being the new Knox College, the administration building of the Toronto General Hospital, and the Lumsden Building. He was born in England, and came to Canada at ten years old, spending practically his whole life in Toronto.

Mainly Constructional

East and West—From Coast to Coast

The indications are that Winnipeg's building in 1916 will be at least double that in 1915.

The Grand Site Construction, Limited, is the name of a new Montreal concern capitalized at $49,000.

The Robert Simpson building at Regina, Sask., is expected to be completed by the middle of April.

The Hamilton Stock Brick Supply Company, Limited, Hamilton, Ont., have been granted a charter.

The Chadwick Brass Company, Limited, Hamilton, Ont., have changed their style to the Wentworth Brass Company, Limited.

Twenty-five building permits, of the value of $26,230, were issued by the city of Quebec during the week ending April 1.

Messrs. Leonard Foulds and A. B. Bowes have opened an office at 166 Bay Street, Toronto, as structural and civil engineers.

The Brown Copper & Brass Rolling Mills, Limited, are erecting a brass rod and shape mill in New Toronto, Ont., at a cost of $125,000.

A two-storey building, finished and ready for occupation in eight days' time, has just been completed in Trail, B. C., by Mr. W. K. Esling.

The Robidoux Sand Company, Limited, has been incorporated with a capital stock of $30,000. The head office of the company is in Montreal.

The Port Hope Manufacturing Company, Port Hope, Ont., expect to start operations at once, and will probably employ about two hundred men.

Construction work on the new building at Winnipeg for the T. Eaton Company is progressing rapidly. All of the caissons are to be completed by April 15.

The Leary Brick Company, of Carman, Man., who have an order for 750,000 bricks for the dome of the Winnipeg Parliament Building, are now turning out 20,000 bricks a day.

During the month of March the city of Montreal issued 119 building permits, of a value of $243,345. In the corresponding month of 1915 171 permits, of a value of $246,695 were issued.

A plan is on foot to revive the granite-quarrying industry on Grindstone Island, in the St. Lawrence River. It is stated that New York parties have leased the property for the purpose of operating it.

F. E. Rivard, A. J. Violette, C. L. Cyr, F. J. Cyr, R. Devost, and E. P. Nadeau, all of Saint Leonard, N. B., have formed a co-partnership to carry on business in Saint Leonard under the style of the Saint Leonard Brick Company.

To overcome the difficulty in securing a proper entrance to the city of Hamilton, Ont., a bridge 1,400 feet in length is planned by the Toronto-Hamilton Highway Commission. The highway and the Hydro radial will both run over the bridge.

During the month of March the city of Vancouver issued 48 building permits, of a value of $205,485, compared with 75 permits, value $30,915, for the corresponding month of last year. For the three months of 1916 the figures are $293,749, as against $271,037 for the same period in 1915.

Figures showing the progress made on the enlarging and finishing work of the Rogers Pass Tunnel from January 27 to February 26, are as follows: East end, main tunnel, 603 ft., total 10,151 ft.; west end, main tunnel, 619 ft., total 8,868 ft. The main tunnel faces, at February 26, were 7,381 feet apart.

Extensive improvements to the water supply of MacDonald College, Montreal, have been completed, and the new plant was placed in operation on April 2. The improvements consist of an elevated steel water-tank, holding 100,000 gallons, supported on four steel columns. A mechanical gravity filter plant has also been installed.

Arrangements for the building of the rear portion of the new City Hall, Winnipeg, are now being seriously considered by the Board of Control. The work is expected to cost in the neighborhood of $200,000, which, covered by a loan at 5½ per cent., would cost the city $11,000 per annum, but would bring all the departments under one roof.

The cornerstone of the Salvation Army's new training college on Davisville Avenue, Toronto, was laid on April 1 by Commissioner W. J. Richards, in the presence of a large gathering. The College, which is being erected as a memorial to the late General Booth, will be one of the most up-to-date institutions of its kind in the country. It is estimated to cost $150,000, and the site comprises eight and a half acres. The building will be four storeys high.

The construction of a twenty-million-dollar bridge across San Francisco Bay, connecting San Francisco and Alameda, is a possibility of the near future. The proposed bridge would be four miles long, and of an average height of 30 feet above the water. The greatest altitude of the bridge would be 125 feet at one place, to permit the passing of lofty-sparred sailing vessels. The plans provide for four railway tracks and two roadways—one for automobiles, the other for slower-moving vehicles.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Clarence Township, Ont.
Jules Bolieu, Clarence Creek, will receive tenders until May 1st on excavation and reinforced concrete work required in the construction of a drain. Plans and specifications with Mr. Bolieau and the Engineers, Magwood & Stidwell, Pitt Street, Cornwall.

Glencoe, Ont.
The Town Council are considering the construction of cement sidewalks on Simpson Street. Clerk, George Wilson.

Leamington, Ont.
The Leamington Electric Railway propose to pave the track allowance with vitrified brick, and will start work shortly. Manager, F. Eastman.

The Town Council contemplate laying a coating of Tarvia on the existing Roc-mac pavement. Clerk, R. M. Selkirk.

London, Ont.
The Board of Control will receive tenders until 10 a.m., April 14th, for the construction of 4,520 feet of sanitary sewer with private connections, etc.

City Engineer H. A. Brazier has prepared plans for sewers, estimated to cost $60,000. Tenders will be called shortly.

Metcalfe Township, Ont.
Tenders on the construction of the Ward Drain will be received until May 1st. Clerk, H. Thompson, R. R. No. 2, Kerwood, Ont.

Nanaimo, B. C.
The City Council propose to construct sewers at an estimated cost of $24,000. Engineer, W. A. Owen.

Ottawa, Ont.
Waterworks Engineer R. L. Haycock is preparing plans for a 15-inch high pressure main on Rideau Street, estimated to cost $6,000.

Pelee Township, Ont.
Tenders on ditching, removal of rock and other work required in the construction of a drainage system will be received until April 28th by the Township Clerk, William Stewart, Pelee Island.

Preston, Ont.
It is probable that the Town Council will shortly commence the construction of a sewer on Fountain Street, estimated to cost $25,000. Engineer, C. S. McKenzie.

Saskatoon, Sask.
City Engineer G. D. Archibald is preparing plans for the construction of a force watermain under the river, at an approximate cost of $20,000.

Vancouver, B.C.
The existing watermains across the First Narrows have to be removed for Government dredging purposes, and the City Council propose to replace them by 12 or 18-inch mains. Engineer, F. L. Fellowes.

CONTRACTS AWARDED

Brantford, Ont.
The City Council have let the contract for supply of salt glazed sewer pipe to the Dominion Sewer Pipe Company, Swansea, Ont., at $3,407.

Burlington, Ont.
The Town Council have let the contract for the supply of 30-inch concrete pipe to B. Blair & Company, Riddell Street, Woodstock.

Leeds and Lansdowne Twps., Ont.
The Township Council have awarded the contract for road work to F. J. Warren, Lansdowne. Approximate cost, $8,000. Stone has been purchased.

Malden Township, Ont.
The contract for the supply of 140,000 tile has been awarded by the Township Council to G. H. Leslie, Amherstburg.

Nova Scotia Province
The Department of Public Works, Halifax, have let the contract for the construction of culverts in Hants County to Arthur Hood, Shelburne, at $11,123.

Railroads, Bridges and Wharves

Calgary, Alta.
The City Council are considering the extension of the street railway to Sarcee Camp. Approximate cost, $10,000. Clerk, J. M. Miller.

Newtonbrook, Ont.
The dam at the Empire Mills, owned by H. Schmidt, has been destroyed by flood, and will be rebuilt.

Nova Scotia Province
The Department of Public Works, Halifax, are having plans prepared for a concrete and steel bridge to be constructed between Annapolis and Granville, at an approximate cost of $80,000. Engineer, W. G. Yorston, Halifax.

Ottawa, Ont.
Plans are to be prepared by the Department of Public Works, Ottawa, for a bridge over the Ottawa River below the Chaudiere Falls.

Victoria, B.C.
The City Council have authorized the construction of a swing span bridge, estimated to cost $9,500, and work will now proceed. Engineer, C. H. Rust.

CONTRACTS AWARDED

Charlotte County, N.B.
The Provincial Department of Public Works, Fredericton, have awarded the contract for steel required in the erection of a bridge over the Waweig River to the Canadian Steel Company, 120 St. James Street, Montreal.

Normanby Township, Ont.
The Township Council have awarded a contract for the construction of a steel and concrete bridge to Alexander Hill. Approximate cost, $4,600.

Simcoe County, Ont.
In connection with the erection of a bridge over the Nottawasaga River for the County Council, the contract for concrete abutments has been let to J. J. Dumond, Brentwood, Ont., and the steel work to the Sarnia Bridge Company, Limited, Sarnia.

Public Buildings, Churches and Schools

Brampton, Ont.
The School Board have appointed W. Connery, Manning Chambers, Toronto, as Architect for the proposed school. Plans will be prepared for a four-roomed brick building.

Cochrane, Ont.
Tenders will be received until 6 p.m., April 25th, on the erection of a school for the School Board, including the wrecking and salvage of the existing building. Estimated cost, $40,000. Architects, Angus & Angus, Angus Block, North Bay. Secretary, W. D. McDouglas.

Exeter, Ont.
Plans are being prepared for alterations to the hall of James Street Methodist Church, to include re-arrangement of basement and installation of a heating system. Approximate cost, $4,000.

Montreal, Que.
Tenders on the construction of fire-escapes at the City Hall will be received until April 15th by A. Chausse, City Hall.

Hogle & Davis, 80 St. Francois Xavier Street, are preparing plans for an addition to the Hervey Institute, 500 Claremont Avenue. Estimated cost, $20,000.

Orillia, Ont.
Work by day labor will start soon on the erection of a Municipal Building on West Street, estimated to cost $50,000. Material will be purchased by tender. Architects, Burke, Horwood & White, Ryrie Building, Toronto.

The Town Council are having plans prepared for an addition to the General Hospital, and tenders will be called shortly. Brick construction, three storeys.

The Town Council have appointed W. H. Croker, Atherley Street, as Architect for the projected addition to the General Hospital.

Portage la Prairie, Man.
The by-law to authorize the raising of $65,000 for the erection of a school has been defeated, and the School Board propose to submit another for $64,500. Chairman, A. P. MacKinnon.

Quebec, Que.
The Anti Tuberculosis League are inviting competitive plans for a hospital to cost about $100,000. Plans to be in by May 1st. President, Arthur Rousseau.

Rapide de L'Original, Que.
The School Board propose to build two schools, at an approximate cost of $3,000. Secretary, E. H. Sabourin.

Regina, Sask.
The City Council have had plans prepared by A. F. Rowley for an addition to the Library, estimated to cost $8,000.

Richmond Hill, Ont.
A by-law will be submitted early in May to authorize the purchase of a site for a Municipal Building. Village Clerk, A. J. Hume.

Shenley, Que.
The School Board are considering the erection of a Model School, at an approximate cost of $9,000.

St. Edourd des Mechins, Que.
Tenders on the erection of a church for the Roman Catholic congregation will be received until April 29th by the Curate, Rev. J. A. Langlois. Approximate cost, $33,000. Architect, Thomas Raymond, 43 Caron Street, Quebec.

Timmins, Ont.
The Presbyterian Congregation propose to build a church. Pastor, Dr. Allen.

Toronto, Ont.
The Provincial Department of Public Works have included in their estimates the sum of $14,000 for construction of fire escapes at the Parliament Buildings. Secretary, H. F. McNaughton.

Tweed, Ont.
A by-law will be submitted shortly to authorize the erection of a High School, at an approximate cost of $15,000. Chairman of the School Board, J. F. Hauston.

Vaudreuil, Que.
The erection of a Convent is being considered by the School Board. Secretary, Evariste Shuve.

CONTRACTS AWARDED

Hull, Que.
In connection with the erection of a church for the Parish of the Holy Redeemer, the contract for terra cotta floor arching has been awarded to the Montreal Terra Cotta Company, Limited, 42 St. Sacrament Street, Montreal.

Maisonneuve, Que.
The contract for installation of seating at the Church of St. Jean Baptiste de LaSalle, has been let to Louis Caron & Fils, Limited, Nicolet, Que.

Montreal, Que.
In connection with the erection of a school and residence for the Cote des Neiges Roman Catholic School Commissioners, the contract for tile work has been awarded to the Smith Marble & Concrete Company, Limited, 145 Van Horne Avenue, and the electrical work to W. J. O'Leary & Company, 36 Recollet Street.

In connection with the church which is being built for the Parish of St. Pierre Claver, the carpentry contract has been let to J. Marcotte, 116 Third Avenue, Maisonneuve, the plastering to Pascal Laroeque, 341 DeLanaudiere Street, and the painting to the general contractor.

In connection with the school now in course of erection on Laverdure Street, the contract for plumbing, electrical work and roofing has been awarded to Vaillancourt & Bastien, 692 Papineau Avenue, and the plastering to H. Mailhiot, 6202 St. Charles Avenue.

The Roman Catholic School Commissioners have let the following contracts in connection with the school on Papineau Avenue:—concrete foundation, Security Engineering & Contracting Company, Limited, 263 St. James Street; carpentry, Guertin & Bouchard, 410 Parthenais Street; cut stone, Megantic Granite Company, Limited, Lake Megantic, Que.

Mt. Denis, Ont.
The Trustees of School Section No. 28 have let the following contracts for the erection of a school:—carpentry, Hudson & Mosely, 5 Jerome Street Toronto; heating, George Sainsbury, Coulter Avenue, Weston; steel, McGregor & McIntyre, 1139 Shaw Street, Toronto; steel sash, H. Hope & Sons, Limited, 45 King Street West, Toronto; plastering, George White, 688 Kingston Road, Toronto. Approximate cost, $25,000.

Pointe aux Trembles, Que.
The general contract for the erection of a portal at the Parish Church has been awarded to Emile Cote, 358 Richelieu Street, Quebec. Estimated cost, $6,000.

St. Luc, Que.
The contract for heating in connection with the Parish Church now in course of erection has been let to J. A. Fournier, 3 Abraham Hill, Quebec.

St. Narcisse, Que.
The general contract for alterations to the Roman Catholic Church has been awarded to Anselme Dube, Bellefeville Street, Three Rivers.

Stamford Township, Ont.
The following contracts have been let for the erection of a school for Union School Section No. 2:—general contractors, W. Utting & Sons, 5 Florence Avenue, Niagara Falls South; masonry, R. J. Jolly & Company, Stanly Street, Niagara Falls South; plumbing, Payne & Nesbitt, 122 Main Street, Niagara Falls South.

Stanstead, Que.
The contract for installation of heating at the Registry Office now being built has been let to E. Conley, 6 Alexander Street, Sherbrooke, and the plumbing to the general contractors.

Business Buildings and Industrial Plants

Barrie, Ont.
W. J. Carmichael, Bell Telephone Company, Montreal, is preparing plans for the proposed office building for the Bell Telephone Company.

Brampton, Ont.
A by-law has been carried granting certain concessions to the Acme Rubber Company, and plans are now being prepared for a factory, estimated to cost $30,000. F. D. Law, 171 Yonge Street, Toronto, is interested.

Forest, Ont.
John Baldry is preparing plans for a store, estimated to cost $5,000. Concrete block construction.

Galt, Ont.
The Perfect Machinery Company, Water Street N., are having plans prepared for a factory, estimated to cost $5,000. Red brick construction.

Halifax, N.S.
S. P. Dumaresq, St. Paul Building, is preparing plans for alterations to the theatre of the Academy of Music, Ltd., Barrington Street. Estimated cost, $25,000. Tenders will be called by the Architect early in May.

Hamilton, Ont.
Ford & Featherstone, 55 King Street W., are considering the erection of a factory for the manufacture of safes, vault doors, etc.

Leduc, Alta.
The Co-operative Elevator Company are considering the erection of an elevator. Particulars from F. Sangster.

Lion's Head, Ont.
Selby Fries is considering the rebuilding of his store, recently destroyed by fire.

Merritton, Ont.
The Moulton Engineering Corporation, 120 Exchange Street, Portland, Me., are preparing plans for a factory addition to be built for the Riordon Pulp & Paper Company. Tenders will be called shortly.

Mitchell, Ont.
The Mitchell Woollen Mills propose to erect an addition to their premises and are negotiating with the Council with regard to the closing of a street.

Montreal, Que.
Tenders will be called shortly for the erection of a factory for L. Wisintainer & Sons, 58 St. Lawrence Boulevard. Architect, L. J. Bigonesse, 92 Notre Dame Street E. Trussed concrete construction.

New Westminster, B.C.
Mosscrop & Whitburn, Western Trust Block, have prepared plans for a theatre for the Alhambra Theatre Company, London, England. Estimated cost, $175,000. Steel and reinforced concrete construction.

Niagara Falls, Ont.
Tenders are now being received for the construction of a greenhouse for W. H. Schoellkoff, Falls View P. O.

The Pollard Manufacturing Company, Welland Avenue, are about to start work on the erection of a foundry, estimated to cost $10,000. Construction will be superintended by F. LeBombard

Port Rowan, Ont.
A. Ferris has commenced the construction of a packing house. Frame construction.

Quebec, Que.
L. A. Cannon has sold a destroyed factory on Collins Street to La Cie de Lithographie de Quebec, and re-building is contemplated. Manager, J. A. Beriault, 180 Cartier Avenue.

Tanguay & Lebon, 20 d'Aguillon St., will call for tenders privately on the erection of an addition to premises on Ste. Helene Street for the Dominion Corset Manufacturing Company, Dorchester Street. Estimated cost, $50,000

(Continued on page 49)

Tenders and For Sale Department

CITY OF SHERBROOKE

TENDERS FOR

One Power Pump and Water Wheel

for the City of Sherbrooke

Tenders addressed to the undersigned will be received until **April 29th, 1916**, at noon, for a power pump of the capacity of four million Imperial gallons per twenty-four hours at not more than thirty revolutions per minute, to work satisfactorily under a dynamic head of 250 feet; also a vertical water wheel (give the name of the maker) flume, shaft, brackets, etc., of sufficient size under a head of eleven feet, to operate the above mentioned pump; the whole to be erected on the foundation made by the city of Sherbrooke, at its waterworks plant "Drummond," on Magog River, a distance of about three and a half miles from the centre of the city. Specification and plan of the power foundation can be seen at the office of City Engineer Tremblay, Sherbrooke, P. Q.

Plan and description of proposal must accompany each tender.

The work to be completed five months after the signing of the contract.

Each bid must be accompanied by a certified cheque equal to five per cent. of the total bid.

The city council reserves the right to reject any or all bids.

E. C. GATIEN,
Secretary-Treasurer.

15-15

TENDERS WANTED

Department of Railways and Canals
Dominion Canals

Notice to Dealers in Cement

Sealed tenders, endorsed "Tender for Cement," will be received by the undersigned up to 16 o'clock on **Tuesday, April 18th, 1916**, for the supply of some 42,000 barrels of cement, more or less, required for the construction and maintenance of the various canals of the Dominion, and to be delivered in such quantities, at such places, and at such times as may be directed.

Dealers in cement may tender for the total quantity required, or for such portions thereof as may suit their convenience.

Specifications, forms of tender and full information can be obtained from the Purchasing Agent of the Department of Railways and Canals, Ottawa, on and after this date.

The Department does not bind itself to accept the lowest or any tender.

By order,
J. W. PUGSLEY,
Secretary.

Department of Railways and Canals.
Ottawa, April, 1916.

Newspapers inserting this advertisement without authority from the Department will not be paid for it. 221 6136. 15-15

FOR SALE

One twelve-ton Austin gasoline road roller, 1914 model Worked three months. In perfect condition. Box 386, Contract Record, Toronto, Ont. 15-16

Hydro Tenders Wanted

Sealed tenders for extension to sub-station building at Edwin and Ruskin Avenues, addressed to the Secretary of the Toronto Electric Commissioners, will be received until noon of **Wednesday, April 19th, 1916**.

Separate tenders will be received for and should be marked as follows: Structural steel work; general and ornamental iron work; roofing and waterproofing; plumbing; painting and glazing; excavating; masonry work.

Specifications and form of tenders may be obtained and plans consulted at Engineering Office, corner Duncan and Nelson Streets. The lowest or any tender not necessarily accepted.

Tenders for Supplies

for the Toronto and York Highway Commission

Tenders will be received up to 6 o'clock p.m., on **April 19th, 1916**, by E. A. James, Engineer, Toronto & York Highway, 57 Adelaide St. East, Toronto, for the supply of Stone, Sand, Road Oil, Road Tar, and Cement during the season of 1916. Specifications and a statement of requirements may be had at the office of the Engineer.

R. W. PHILLIPS, Secretary.
T. FOSTER, Chairman of the Board. 15-15

For Sale

Concrete Plant and Gravel Yards for sale, at Wallaceburg, Ont. New, up-to-date, fully equipped with dry kilns and machinery; good location; four hundred feet along main street river front; block building 34 x 137 ft., one storey high, iron roof; good stock of sand and gravel. Reason for selling, death of owner. Apply Mrs. Anna Mae McDougall, Box 9, Wallaceburg, Ont. 14-15

Late News Items

Laval, Que.
The Town Council will receive tenders until April 25th for macadamizing the roads of Bout de l'Ile. Plans and specifications at office of the Secretary, Richmond Delelles, Pointe aux Trembles, Que.

Levis, Que.
J. Blais is building two residences for J. Samson and Alcide Samson. Approximate cost, $7,000 each. Architect, L. E. Auger, 39 St. Jean Street, Quebec.

Port Colborne, Ont.
The Canada Cement Company, Montreal, will receive tenders until April 29th for the construction of about 7,000 square yards of concrete roadway at the Company's plant. Plans and specifications at the Port Colborne office.

St. Albans, Que.
The contract for concrete foundations for the plant of the Portneuf Hydro Electric Company has been let to Archibald & Conway, 332 Bleury Street, Montreal, and the contract for equipment to the Electric Company, Minneapolis, Ind.

St. John, N.B.
The contract for sash required in alterations to the premises of the W. H. Thorne Company, Limited, Prince William Street, has been let to A. B. Ormsby Company, Limited, King Street West, Toronto.

St. John's, Nfld.
A. D. Swan, 10 Phillips Place, Montreal, Engineer to the Anglo-Newfoundland Development Company, is in the market for cranes, transporters and electric conveyors for harbor equipment.

St. Louis de Terrebonne, Que.
The Municipal Council propose to spend $9,000 on roads during the season. Secretary, Aime Masson, Terrebonne.

Toronto, Ont.
Purton & Chennels, 156 Ellsworth Avenue, propose to build duplex residences on Frederica Street, at an approximate cost of $8,000, and may start work shortly. Brick construction.

The following sub-contracts have been let in connection with the erection of a warehouse for the Robert Simpson Company, Limited, 176 Yonge Street:--plumbing, heating and sprinkler system, Purdy Mansell, Limited, 63 Albert Street; glazing and glass, Imperial Glass Works, 35 Mutual Street; painting, F. G. Roberts & Company, 106 Wells Street; ornamental iron, fireproof doors, etc., Ornamental Bronze & Iron Works, 83 Ryerson Avenue; elevators, Otis Fensom Elevator Company, Ltd., 50 Bay Street.

The Toronto & York Highways Commission will receive tenders until April 19th on the supply of stone, sand, road oil, road tar and cement during the season. Engineer, E. A. James, 57 Adelaide Street E.

C. H. Pickering, 200 Rushton Road, proposes to build duplex residences, estimated to cost $8,000, and will let the smaller trades. Brick construction.

West Lorne, Ont.
Tenders on the erection of an addition to the school will be received until April 15th by D. McPherson, Secretary to the School Board.

Miscellaneous

Galt, Ont.
The Shurly Dietrich Company, Ltd., are in the market for 100,000 feet of beech. Prices f.o.b. Galt.

Three Rivers, Que.
Prices and other information with regard to the following materials are desired by Anselme Dube, Contractor:—brick, cement, fireproofing, granite, hollow tile, steel, metal lath, metal sash, plumbing fixtures, woodworking machinery.

Victoria, B.C.
The Purchasing Agent, W. Galt, will receive tenders until April 17th for the supply of 225 tons of mineral dust, 1,400 cubic yards of sand for asphaltic paving, and 300 tons of asphaltic cement.

Business Buildings and Industrial Plants

(Continued from page 47)

Rossland, B.C.
The Fraternal Order of Eagles are considering the erection of a hall.

St. Helene de Breakeyville, Que.
John Breakey is considering the construction of a sawmill, at an approximate cost of $7,000.

St. Honore, Que.
The erection of a convent will be commenced in June, under the supervision of the Curate, Thomas Cloutier. Approximate cost, $8,000.

St. John, N. B.
F. Neil Brodie, 42 Princess Street, is preparing plans for alterations to the premises of T. McAirty & Sons, King St.

St. John's, Que.
Work has started on the re-building of the furniture factory owned by D. H. Langlois & Company. Approximate cost, $8,000.

Toronto, Ont.
The Toronto Electric Commissioners, 226 Yonge Street, will receive tenders until April 19th on the following trades required in the erection of an addition to the sub-station at Ruskin and Edwin Streets:—structural steel, general and oranmental iron work, roofing and waterproofing, plumbing, painting, excavating and masonry. Plans and specifications at Engineering Office, Duncan and Nelson Streets.

Work has been started on the erection of an office building for the Toronto Suburban Railway Company, 936 Keele St., under the supervision of the Architect, G. C. Briggs, 34 Victoria Street. Steel and brick construction. Approximate cost, $15,000.

Plans are being prepared for a block of stores and apartments to be built by Adam Walker, 169 Lauder Avenue, at an approximate cost of $25,000. Brick construction.

J. Crang, 906 St. Clair Avenue W., propose to build a block of stores and apartments, at an approximate cost of $12,000. Brick construction.

Trail, B.C.
F. G. Quimby has prepared plans for a Fire Hall for the City Council, and tenders will be called shortly. Brick construction. Estimated cost, $5,000.

Welland, Ont.
John Cooper, Dexter House, will receive tenders until April 15th for the erection of a laundry on Patterson Avenue. Estimated cost, $3,000. Architect, D. F. Forbes, Temple Building. Brick and tile construction.

Weston, Ont.
A. B. Moffatt, Main Street, has applied to the Township Council for fixed assessments contingent upon the erection of a factory, estimated to cost $60,000.

CONTRACTS AWARDED

Ailsa Craig, Ont.
The general contract for remodelling a store for Mrs. Munro, Main Street, has been let to W. D. Yelf, and the carpentry to Gibson & Son, Lucan.

Brantford, Ont.
Most of the smaller contracts in connection with the erection of a station for the Lake Erie & Northern Railway Company have been let to the general contractors, Schultz Brothers Company, Limited.

Drummondville, Que.
The general contract for the construction of a sulphuric acid plant for the Aetna Chemical Company of Canada, Limited, has been awarded to the Westinghouse Church Kerr Company, New York City. Approximate cost, $300,000.

Hamilton, Ont.
The general, masonry and steel contracts for an addition to the premises of the Canadian Hart Wheels Company, Burton Street E., have been let to William Yates, Jr., 24 Leeming Street. Approximate cost, $7,000.

Kingston, Ont.
The City Council have let the general contract for the erection of a storehouse to A. McCartney, University Avenue. Brick and reinforced concrete construction. Approximate cost, $10,000.

Lindsay, Ont.
The general contract for the erection of a factory on William Street for Horn Brothers has been let to Reese Williams, William Street. Architects, T. Pringle & Son, Continental Life Building, Toronto.

London, Ont.
The contract for heating and plumbing in connection with the erection of a dance hall for Halls, Limited, has been awarded to T. L. Partridge, 430 Wellington Street.

H. Hayman, 491 Ontario Street, has been awarded the general contract for the erection of a store and residence on Dundas Street for Charles Dyson, 779 Dufferin Avenue. Approximate cost, $7,000.

The contract for remodelling the premises of Miss F. A. Mitchell, 114 Dundas Street, has been awarded to John Putherbough, 1006 Wellington Street. Estimated cost, $10,000.

Macksville, Ont.
The general contract for alterations to the barns of Neil Carruthers, Macksville, has been awarded to Dougal Black, Appin.

Maisonneuve, Que.
In connection with the store which is being built on Ontario Street for Dufault & Reed, 575 Notre Dame Street, the contract for brick work and masonry has been let to J. P. Desjardins, Limited, 162 St. Jeanne d'Arc Avenue, and plastering to E. Tessier, 270 William David Street, and the carpentry and interior fittings to the general contractor.

Montreal, Que.
Work has been started on the construction of a garage for William Scully, 320 University Street. The general contract has been let to J. Wighton, 19 Sussex Street. Estimated cost, $3,000.

The contract for foundations and substructure required in the erection of a boiler room for the Montreal Tramways Company has been let to Laurin & Leitch, 5 Beaver Hall Square.

Montreal West, Que.
F. J. Friedman, 357 St. Catherine St. W., Montreal, is building a refrigeration plant for the Elmhurst Dairy Company, Limited.

Ottawa, Ont.
In connection with the stores which are being built by James and Frank Wilson, 8 Allan Place, the heating and plumbing contract has been let to Gervin & Lillico, 1095 Bank Street, and the electrical work to P. Ackroyd, 416 Bank Street.

Quebec, Que.
The contract for roofing, heating, plumbing and electrical work required in connection with the store now being built for J. N. Rondeau, 6 Lachevrotiere Street, has been awarded to A. Noreau, Fifth Avenue, Domaine Lairet, and the painting to Garneau & Artean, 230 d'Aguillon Street.

J. A. Voyer, 63 Scott Street, has let the general contract for the erection of a store and residence on Artillerie St. to W. Boucher, 42 Bayard Street. Estimated cost, $5,000. Brick construction.

St. Catharines, Ont.
Work has been started on the erection of a factory for the Dominion Food Company, Russell Avenue. The general contract and masonry have been let to Newman Brothers, St. Paul Street, and the carpentry to C. F. Monk, Wilson Street Approximate cost, $20,000.

Stratford, Ont.
The general contract for an addition to the premises of the Williams Trow Knitting Company, St. Patrick and Erie Street, has been let to the Metal Shingle & Siding Company, Preston.

The contract for plumbing and sheet iron work required in connection with the addition to the premises of the Avon Hosiery Company, Erie Street, has been awarded to J. R. Myers & Sons, 99 Ontario Street, and the painting to A. Cash, 168 Ontario Street.

Toronto, Ont.
The contract for masonry required in the erection of a garage for W. J. Fennell, 6 DeLisle Street, has been let to the Britnell Contracting Company, Baxter Street, and the steel work to Canadian Allis-Chalmers Ltd., 212 King St. W. Approximate cost, $10,000.

The contract for masonry required in the erection of a business block at Bloor and North Streets for F. Nicholls has been awarded to William Edwards, 337 Rusholme Road, and the carpentry to Hudson & Mosley, 5 Jerome Street.

The general contract for re-building the Princess Theatre has been let to Farrington Construction Company, Detroit, Mich. Smaller trades will be sub-let. Approximate cost, $200,000. Architect, C. Howard Crane, Ford Building, Detroit.

Residences

Brigden, Ont.
John Poland is preparing plans of a residence, estimated to cost $3,000 Frame and white brick construction.

E. Johnston has commenced the erection of a residence, estimated to cost $3,000 White brick construction.

City View, Ont.
John R Daoust, Raden Avenue, is about to rebuild his residence, at an ap-

proximate cost of $3,000. Electrical work may be let. Frame construction.

Exeter, Ont.

The erection of a residence is contemplated by Ernest Davis. Estimated cost, $3,000.

Georgetown, P.E.I.

John Stewart proposes to build a residence, at an approximate cost of $4,000.

The erection of a residence is being considered by John Dalziel. Estimated cost, $3,500.

Grafton, N.B.

The erection of a residence is being considered by H. Smalley. Approximate cost, $3,000.

Halifax, N.S.

The Eastern Investment Corporation, Cragg Building, will receive tenders until May 1st for heating, plumbing and electrical work required in the erection of a residence on Larch Street.

Hamilton, Ont.

Plans have been drawn for three residences to be built by D. Hamilton, 1306 King Street E. Frame construction. Approximate cost, $3,600.

Ingersoll, Ont.

New plans are being prepared for the residence to be built on Thames Street for F. Wright, care of Wright Dry Goods Company. Red brick construction. Approximate cost, $4,000.

Tenders on the erection of a residence are being received by G. C. Wright, care of Wright Dry Goods Company. Approximate cost, $5,000.

Kingston, Ont.

Thomas Andre, 240 Earl Street, is about to commence the erection of two residences, estimated to cost $5,200. Brick construction.

London, Ont.

Hyatt Brothers, 288 Egerton Street, will shortly commence the erection of three residences on Ridout Street South, estimated to cost $10,000. Tapestry brick construction.

Plans of four bungalows to be built on Windsor Avenue are being prepared by Norman S. Roberts, care of Roberts Engraving Company, Dundas Street. Approximate cost, $11,000. Stucco construction.

Max Lerner, 502 Hill Street, is about to prepare plans for an apartment house to be built on Dundas Street, at an approximate cost of $25,000. Carbex brick construction.

J. C. Anderson, Industrial School, is preparing plans of a residence to be built on Duchess Avenue, at an approximate cost of $3,500. Red pressed brick construction.

Plans will be prepared by T. H. Janes, Market Lane, for three residences to be built on Bruce Street. Approximate cost, $10,000.

Watt & Blackwell, Bank of Toronto Building, are preparing plans of a residence to be built for H. N. Abel, 61 Craig Street. Approximate cost, $10,000. Tapestry brick construction.

D. A. Graham, 3 Perry Street, proposes to build three residences, and is preparing plans. Red pressed brick construction. Approximate cost, $10,000.

Plans are being prepared for a number of residences to be built on Hamilton Road for Mrs. Mary Graham, Marmora Street. Estimated cost, $10,000. White Brick construction.

R. H. Smith, 191 Wharncliffe Road, is preparing plans for a bungalow, estimated to cost $3,500. Tapestry brick construction.

A. Evans, 905 Queens Avenue, has prepared plans for a residence, estimated to cost $3,000, and will shortly start work. Brick construction.

H. Pocock, 552 King Street, will shortly commence the erection of two residences. Red pressed brick construction. Approximate cost, $7,000.

Lynnville, Ont.

The erection of a residence is contemplated by William Walmsley. Approximate cost, $3,000.

Middle Sackville, N.B.

Rev. A. V. Landry proposes to rebuild his residence this spring.

Montreal, Que.

F. A. Job, 163 Jacques Street, has commenced the erection of a residence. Approximate cost, $3,000.

Ottawa, Ont.

Mark Wilson, 61 Irving Avenue, is considering the erection of a residence, estimated to cost $4,000. Brick veneer construction.

Port Colborne, Ont.

Russell Adams is considering the erection of a residence on Elm Street, to replace that destroyed by fire.

Quebec, Que.

Lavoie & Frere, 52 Jeanne d'Arc St., are preparing plans of a residence to be built on Cartier Avenue, at an estimated cost of $10,000. Brick construction.

M. Cauchon, 309 Richardson Street, will shortly start work on the erection of five residences, estimated to cost $20,000. Artificial stone construction.

Roundhill, Alta.

M. M. Burkholder, Dodds, Alta., is about to start work on the erection of a residence and barn.

Seaforth, Ont.

James Watson is considering the erection of a residence and will prepare plans. Estimated cost, $3,000.

St. Elie de Caxton, Que.

Denis Brodeur is considering the erection of a residence, at an approximate cost of $3,000.

Toronto, Ont.

J. Lucan & Company, 508 Dupont St., are receiving tenders for finishing three residences on Arlington Avenue. Work includes carpentry, plastering, painting, glazing and galvanized iron work.

J. G. Hough, 346 Parliament Street, is receiving tenders on concrete foundations for five residences in the Todmorden District.

J. F. Alexander, 8 Temple Avenue, is about to commence the erection of a duplex residence at an approximate cost of $7,000, and requires tenders immediately on excavation. Brick construction.

W. P. Levack, 519 Roxton Road, has started work on the erection of a residence on Gothic Avenue, estimated to cost $3,800. Smaller trades will be let. Brick construction.

A. A. Mitchell, 502 Palmerston Avenue, has commenced the erection of a duplex residence, estimated to cost $6,500. Smaller trades will be let.

Work has been started by William Davis, 3 Scarboro Road, on the erection of a residence, estimated to cost $3,500. Smaller trades will be let.

H. Lucas, 118 Felstead Avenue, has commenced the erection of a pair of residences, estimated to cost $4,000. Smaller trades will be let. Brick construction.

McIlroy & Lowry, 105 Clendennan Avenue, have commenced the erection of two residences, estimated to cost $6,000. Smaller trades will be let.

E. Gagnon, 2359 Queen Street E., is receiving tenders on all trades required in the erection of apartments, estimated to cost $20,000. Brick construction.

J. D. Naylor, 129 Glenholme Avenue, has commenced the erection of a residence, estimated to cost $3,500, and is receiving tenders on smaller trades. Brick construction.

Work has been started by S. B. Green, 111 Evelyn Crescent, on the erection of a residence on Conduit Street. Approximate cost, $3,000. Smaller trades will be let.

Walkerville, Ont.

Harold Wilson, Windsor, will shortly start work on the erection of two residences at Windermere and Cataraqui Streets.

Plans are being prepared for a residence to be erected for Mrs. E. C. Walker, Willistead, Walkerville. Work may start this season.

Welland, Ont.

D. F. Forbes, Temple Building, is preparing plans of a residence for D. Dick, Jr. Estimated cost, $10,000. Brick construction.

CONTRACTS AWARDED

Fonthill, Ont.

The following contracts have been let for the erection of a residence for F. Wellington:—masonry, F. Hoare, St. Paul Street, St. Catharines; carpentry, C. F. Monk, Wilson Street, St. Catharines; electrical work, Clifford Electric Company, Ontario Street, St. Catharines; heating and plumbing, J. Peart, King St., St. Catharines; painting, Rachar & Hyatt, 86 Main Street, Welland; plastering, Dakers & Hemphill, 51 St. Catharine Street, St. Catharines.

Halifax, N.S.

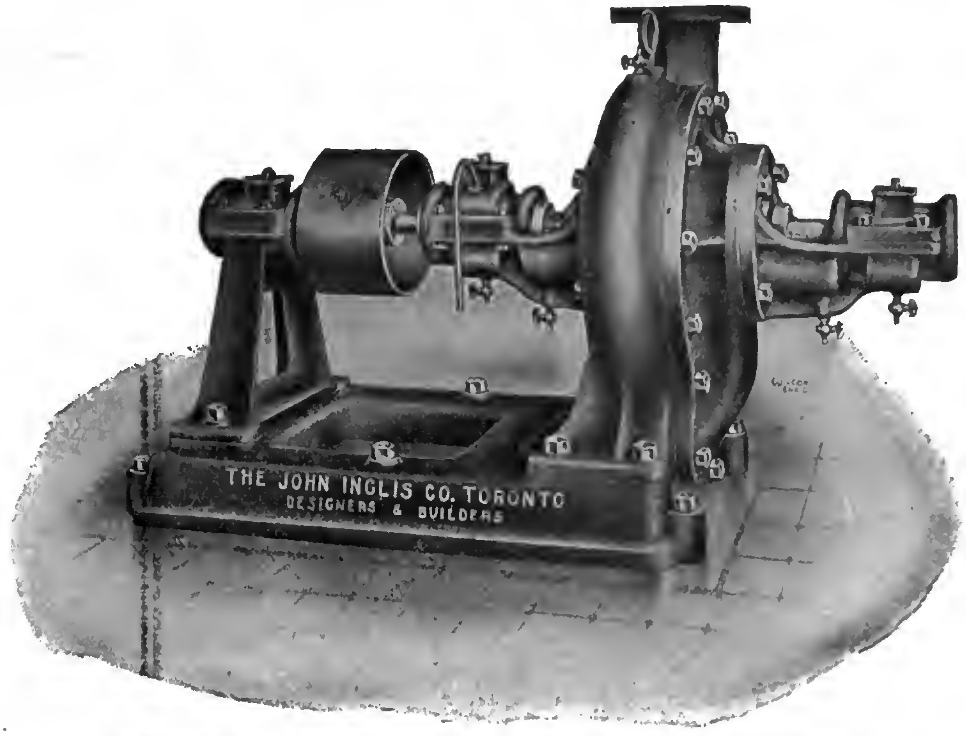
The Eastern Investment Corporation, Limited, Cragg Building, have awarded the following contracts in connection with the erection of a residence on Larch Street and flats on LeMarchant Street:—heating, Longard Brothers, 213 Hollis Street, plumbing, W. S. Craig, 316 Upper Water Street; electrical work, J. Starr, Son & Company, Granville Street.

Hamilton, Ont.

The following contracts have been awarded in connection with the residences which are being built by J. H. Somerville, 166 Prospect Street:—masonry, Lemington & White, 140 Rosslyn Avenue; plastering, Fred Mountain, 35

(Continued on page 52)

PUMPS



Horizontal Belt Driven Turbine Pump supplied the University of Toronto.

THIS Pump is hydraulically balanced against end thrust and in addition has a water cooled thrust Bearing. The Pump is arranged so that it may be operated with guide vanes or without for demonstration purposes. Oil ring bearings, Hydraulic Balance and water cooled thrust bearings are standard for all "Inglis" Turbine Pumps.

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Residences

West Avenue N.; heating and plumbing, H. Barnes, 93 Clyde Street; electrical work, T. Thornton, 174 Balmoral Ave.

R. S. Mason, 43 Kensington Avenue, is building five residences, estimated to cost $3,000 each, and has awarded the contract for masonry to Lemington & White, 140 Rosslyn Avenue.

The general contract, masonry and carpentry for the erection of residences for R. Sharp, Alexandra Street, Mountain Top, have been awarded to Andrew Spittal, 489 Concession Street. Brick construction. Approximate cost, $3,500.

Kingston, Ont.

The general contract for the erection of a residence for J. Connor, 575 Princess Street, has been awarded to James Gough, 170 York Street. Pressed brick construction. Approximate cost, $3,500.

Work will start shortly on the erection of an apartment house for James Elder, 207 William Street. The masonry has been let to H. W. Watts, 98 Frontenac Street, the carpentry to Henry Hunter, 332 Barrie Street, plumbing to Elliott Brothers, 77 Princess Street, electrical work to H. W. Newman Electric Company, 79 Princess Street, and painting to T. Milo, Princess Street.

Lachine, Que.

The general contract for the erection of residences for G. Guzzi, 43 Notre Dame Street, has been awarded to B. Lacolli, 70 Tenth Avenue. Brick construction. Estimated cost, $3,000.

Levis, Que.

The general contract for the erection of a residence for A. Cherrier, Bienville, has been let to J. Blais, Levis. Estimated cost, $4,000. Brick construction.

London, Ont.

The general contract for the erection of a residence for James R. Haslett, 521 Richmond Street, has been let to H. Hayman, 491 Ontario Street. Approximate cost, $3,500.

Work is about to start on the erection of a residence for D. J. Ferguson, 503 Quebec Street. Estimated cost, $4,000.

Hyatt Brothers, 288 Egerton Street, are about to start work on the erection of a residence for Charles Gilbert. Approximate cost, $4,000. Red pressed brick construction.

The general contract for the erection of a residence on Hill Street for Charles Lee has been awarded to Hyatt Brothers, 288 Egerton Street. Red pressed brick construction. Approximate cost, $3,500.

The general contract for the erection of a residence for D. C. McNaughton, care of McCormick Manufacturing Company, has been let to Harry Hayman, 491 Ontario Street. Approximate cost, $4,000.

Work is about to start on the re-building of a residence for James Black, care of Grigg House. The general contract has been let to Jones Brothers, Hamilton Road. Estimated cost, $3,000.

The general contract for the erection of a residence for George Mills, 527 Dundas Street, has been let to Harry Hayman, 491 Ontario Street. Red pressed brick construction. Approximate cost, $3,000.

C. J. Pink, 451 Hamilton Road, has awarded the general contract for the erection of a residence to Tutt & McRae, 90 Chesley Avenue. Red pressed brick construction. Estimated cost, $3,500.

Maisonneuve, Que.

The contract for carpentry in connection with the residences in course of erection for M. & O. Dufresne has been let to I. Allard, 1360 Des Erables Street, and for asphaltic mastic roofing to H. H. Symmes & Brothers, 42 St. Sacrament Street.

Montreal, Que.

The contract for electrical work required in connection with alterations to a residence for A. P. Stuart, 27 Summerhill Avenue, has been let to E. A. Gregory, 1594 Cadieux Street.

Quebec, Que.

The contract for carpentry required in the erection of a residence for James Brown, 71 Fleurie Street, has been awarded to E. Morissette Ltd., 208 Latourelle Street, the roofing to N. Barbeau, 36 Bridge Street, and the heating, plumbing and electrical work to D. Cote, St. Louis de Courville, Que.

The contract for painting in connection with the erection of a residence for Boisvert & St. Laurent, 56 d'Artigny Street, has been awarded to A. S. Bedard, 116 Des Stigmates Street, and the heating, plumbing and electrical work to A. Fournier, Abraham Hill.

Raleigh Township, Ont.

The general contract for the erection of a residence for George Davidson, R. R. No. 6, Chatham, has been let to Robert Lewis, 120 St. Joseph Street, Chatham. Estimated cost, $5,000.

Sarnia, Ont.

The general contract for the erection of a residence for W. A. Watson, Front Street, has been let to David Giffin, the masonry to E. McDonald, and the plumbing to F. Goodwin & Company, 215 Christina Street. Frame and stucco construction. Approximate cost, $4,000.

St. Catharines, Ont.

The following contracts have been let in connection with the residence in course of erection for A. F. Fifield, 157 Ontario Street:—masonry, Newman Brothers, 71 St. Paul Street; carpentry, steel work and roofing, R. B. Williams, Beecher Street; heating and plumbing, H. A. Bald Company, Academy Street; plastering, Dakers & Hemphill, 51 St. Catharine Street; painting, Leach & Jones, James Street; electrical work, Sandham & Roberts, St. Paul Street.

Toronto, Ont.

Work is about to start on alterations to the residence of F. G. B. Allan, 6 Wellesley Place. The contract has been let to F. Browning. Tenders are being received for excavation. Approximate cost, $4,500.

W. R. Maton, 173 Glenholme Avenue, has been awarded the general contract for the erection of a residence for F. Trelford, 1036 St. Clair Avenue West. Stucco and tapestry brick construction. Approximate cost, $5,000.

Walkerville, Ont.

The general contract for the erection of a residence on Kildare Road for F. E. Allum, Detroit, Mich., has been awarded to Euclide Jacques, 87 Assumption St., Windsor, and the masonry to Cross Brothers, 25 Louis Avenue, Windsor.

Westmount, Que.

Anglins, Limited, 65 Victoria Street, Montreal, have commenced the erection of a residence on Willow Avenue N. for Harding & Heward, and are receiving tenders on roofing and electrical work. Approximate cost, $14,000.

Windsor, Ont.

The general contract for the erection of flats on Dougal Avenue for Mrs. G. Hallett, Langlois Avenue, has been awarded to Lambert & Braithwaite, 10 Riviera Street, Sandwich. Approximate cost, $8,000.

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Vol. 30 **April 19, 1916** **No. 16**

Principal Contents

Decent Consideration

Dean Cappon, of Queen's University, voices the sentiments of a very large percentage of the Canadian people when he says: "Let there be decent consideration for those who think they have good enough reasons not to go, at least as yet, to the war."

Possibly, if Dean Cappon spoke all that is in his mind, he would put it more strongly. Doubtless he has seen the ill-advised methods of recruiting that are being utilized from day to day by the rank and file of various battalions. Doubtless he realizes that the present system of semi-coercion has little to commend it, and in a very large number of cases does more harm than good. Its biggest weakness, perhaps, is that it fails to discriminate between the man who holds back because he is a coward and the man who delays because his intelligence tells him that his proper place, as yet, is where he is.

The methods of recruiting as practised in Canada, if Toronto may be taken as a criterion, lack nothing so much as intelligence and good sound horse-sense. There is ample and laudable enthusiasm—but misdirected. Khaki enthusiasts fail to see, or refuse to see, that the business of the country is next in importance to the war, and as such demands fair consideration. They fail, or refuse, to see that many a young man, however desirable as a member of their unit, may be, by comparison, still more useful as a civilian in this present time of stress. They fail, or refuse, to grant to the intelligent individual the right to use his own judgment as to when is the proper time for him to give up the one and take hold of the other. In other words, the present system of recruiting is specially designed for the dilettante, the indifferent, the man lacking in moral and mental fibre; it is a reflection on the man who does his duty as he sees it.

* * *

All of this, and more, no doubt, Dean Cappon has prominently in mind when he makes a plea for merely "decent consideration" for the men who do their own thinking. If these men had followed the line of least resistance many of them would have been in uniform months ago. Fortunate it is, as we see it, that, in the absence of the slightest apparent effort on the part of our Government to cope with this problem of filling up the ranks of the numerous battalions they have authorized, there are men strong enough to brave the jibes and insinuations of these miscellaneous, misguided recruiting agents. They are simply making juvenile attempts at a man's job! How can we combat efficiency except with efficiency?

The men who are strong enough to "think" today, men who are strong enough to resist following the lines of least resistance, cry out for some movement on the part of our Government which will enable us, as a nation, to carry on our share of this war in such a way as to conserve in the best possible manner our fighting resources—present and future. There is not a man of these who is not ready to go when and where he is told—if the authority who gives the order **knows.** Why doesn't our Government find out? Why hasn't it an inventory of every citizen of Canada, that it could say to him, "Here is your place!"? But instead of acting, our Government delegates this authority to the illiterate private in the ranks, and, indirectly at least, authorizes the man of small intelligence to badger and coerce the man who sees his duty clearly and is doing it. Why cannot our Government move in this matter? Why cannot they give so important a question at least "decent consideration"?

Mountains of Northern Labrador

The regular monthly meeting of the C. S. C. E. was held in the Chemistry and Mining Building of the University of Toronto at 8 p.m. on April 13. A very interesting descriptive address was given by Prof. A. P. Coleman, entitled "A Visit to the Mountains of Northern Labrador."

The speaker described how, to reach Torngat Mountains in Northern Labrador, 1,300 miles from Toronto as the crow flies, he had to travel a roundabout way of 4,000 miles—by rail to Sydney, N.S., ice-breaker "Bruce" to Port aux Basques, Nfld., railway (3½ ft. gauge) to St. John's, steamer to Main on Labrador coast, motor boat to Hebron (last Moravian settlement); balance of the way to Komaktorvik Bay, latitude 59 degs. 30 min. in a fishing skiff with two Eskimos.

Prof. Coleman mapped the country in the neighborhood of Komaktorvik Bay. The highest mountain was 4,700 feet—which, of course, the Professor, as usual, climbed: one of Dr. Coleman's recreations is reaching the highest point of the highest mountains. Proceeding southward, Nakvak Fjord, which the speaker described as comparable in beauty with the fjords of Norway, was also explored. In this neighborhood the highest summit reached 5,000 feet.

Various items of keen interest to his listeners were noted by Dr. Coleman as the lecture proceeded. He spoke of the fine trout in the northern rivers, the largest he had ever seen, golden and copper color, and more than two feet long. He spoke also of the great number of ice-floes encountered on the journey to and from the north land, and the influence these must have on future navigation possibilities in and around Hudson Bay. On the various mountains glaciers were very frequently met with.

Bids, Bidders and Bidding

By G. Alexander Wright

To bid or not to bid? That is the question—whether it is better to be idle and save money, or take a job and lose it?

Is it any use to figure? That is the perplexing question of today for the competent and careful bidder, for he knows that the more competent and careful he is, the less chance he has of competing and getting a job with any profit in it. It certainly looks as if our present estimating methods are a failure from the bidder's standpoint. What is to be done?

Is it that there are not jobs enough to go around? Or, are there too many bidders? And are they too aggressive, too eager for the good of the business? One thing is certain, that so-called competition among the building industry has degenerated largely into cut-throat practices, and trade destruction.

If bids to owners are so low that the contractor is unable to make a profit legitimately, what happens, and whose fault is it? Is it the owner's? Is it the architects's? We think not. It is well known that many architects do not favor such conditions. They will, when about to invite bids, prepare their list of bidders, say eight responsible and well-known contractors, sufficient competition surely, one would think (especially as the owner is not paying for the time and study these eight men will give to his plans and specifications). Then see what happens! First the subs get wind of it, then the material men; these tell their friends, their customers and other material men that such and such an office is taking figures on a job. Those in the game know what follows. By the time bids are actually received the architect is unwillingly swamped with bids, good, bad and indifferent. Probably fifteen or twenty. The usual result is that the better, or rather more competent type of contractor, is badly beaten by the "uninvited" bidders, who force their way in and crowd them out, by submitting ridiculously low bids, based, generally speaking, upon incorrect quantities, and not incorrect prices.

Such methods destroy what the better class of architects seek, viz: "legitimate" competition. Where in the name of common sense, is the logic of this? Nobody is benefitted by such methods, not even the uninvited bidders themselves. Such men, however, are largely responsible for the ruinous and demoralized condition of the building business today. These men will beg almost for the chance to figure a job, regardless of anything. There are architects who realize the conditions and will try and stand such bidders off, at the risk of making an enemy. But it is no use. They take it as a personal affront if refused. Sometimes other means have to be adopted, to save these bidders from themselves, to save them wasting their time, but this is seldom appreciated.

Some way must be found of identifying these kinds of bidders, if they belong to an organization, and of convincing them of their folly, and of the great injury they do the building business as a whole. Should this prove insufficient, then other means might be adopted. Something must be done, and soon. That is certain.

It is so easy to blame architects for the conditions, but the truth is the remedy lies among the bidders themselves. If the latter want a square deal, they can get it. If they want better conditions, it is within their power to get them. But they must act, and co-operate. Other objectionable features of present loose practices are a source of inconvenience to the architects, the majority of whom would appreciate better methods among contractors. If the architect selects a sufficient number of bidders for a job, why should bidders compel them, almost, to increase their list two and three fold? Then there are the numerous and entirely unnecessary interruptions the architect experiences answering inquiries after bids are opened. Not from the bidders originally selected, nor even from the uninvited bidders, but from the almost endless number of sub-bidders, specialty men, material men who have given figures to the bidders, and who afterwards keep the architect's office busy answering inquiries about the bids, instead of getting their information direct from the bidders for whom they figured. Even if bids are to be opened at a fixed time in the presence of bidders, it is found that even this does not obviate these objectionable features, as it certainly should.

The whole question is a complex one, it is true, but the bidders themselves can do something, and a great deal, if they will but co-operate towards improving conditions. It is up to the men in the business.

These columns are always open to a discussion of these subjects, and to suggestions in aid of betterment. We shall be glad to publish our readers' opinions concerning "Bids, Bidders and Bidding" in future issues, either with or without their names appearing.

All we want is practical facts and suggestions for betterment. Every reader has some ideas, and all are at perfect liberty to express them. Let us hear from you. Address "Editor" Contract Record, Toronto.

The Pittsburgh-Des Moines Steel Company, Pittsburgh, Pa., are distributing a new illustrated booklet on railway service tanks. There is considerable information in this booklet which will be of interest to our readers. One of the illustrations, which are numerous, shows a 100,000-gallon-capacity tank installed for the Grand Trunk Pacific Railway at Melville, Sask.

Shall I Build Now, or Wait? Comparative Prices Today and at Outbreak of War

[Continued from April 12]

ALTHOUGH, generally speaking, the two main items entering into the cost of a building, other than steel construction, are the masonry and the carpentry, there are a variety of miscellaneous items to be considered which in the aggregate are as important as either of these. Indeed, one would not be far wide of the mark if he divided the ordinary building under these three headings—mason, carpenter, miscellaneous—allowing each of them one-third of the total cost.

Under miscellaneous, fall such items as heating, plumbing, painting, glazing, trimming, hardware, plastering, wiring, and so on. How does the price of these items today compare with prices at the outbreak of war?

In two previous issues we have published information with respect to the mason and carpenter contracts. Roughly summarized, the masonry cost, one-third of the total cost, has been reduced anywhere from 10 to 20 per cent: carpenter work, another third, remains practically the same, with a slight tendency to increase. Therefore, if the cost of the items which fall under the head of "Miscellaneous" have not increased more than 10 to 20 per cent., to offset the saving in masonry costs, it is evident that building today is at least no more costly than at the outbreak of war.

Hardwall Plaster

The prices of hardwall plasters, now generally used on better-class buildings, were exceptionally low for some months after the war broke out. Within the last few months, however, one manufacturer reports that a considerable advance has taken place, until today neat hardwall plaster will perhaps average 15c to 20c per ton higher than in August 1914: this represents an increase of only 3 or 4 per cent, however. Another manufacturer states: "We have made very few changes in our prices, and where we have there has been a slight reduction. There is every indication that, instead of prices advancing because of the high cost of production, 1916 prices will be lower than last year, due to the keen competition caused by the necessity of each manufacturer securing a fair share in a shrinking market so as to keep his organization together."

Price conditions in this material vary somewhat in various localities, however. In the city of Montreal the competition was so keen for a time that a reduction from $11 to $6.50 held for several months. In the maritime provinces, on the other hand, we are advised the price of hardwall plaster has just been increased 70 cents per ton, and the trend of prices has been upward. The tariff, too, has been a contributory factor, as many of the materials used in the manufacture of hardwall plaster come from the United States.

Plumbing and Heating

There are many items which enter in these contracts and we are indebted to the James Morrison Brass Manufacturing Company, Toronto, for the following interesting information:—

"The price of seamless drawn brass tubes advanced about 100 per cent. between August 1914 and August 1915, and the price today as compared with that of 1914 is an advance of 120 per cent. Brass rod and sheet brass advanced 100 per cent. between August 1914 and August 1915, and present prices are 165 per cent. of that of August 1914.

"Regarding raw metal, such as copper, tin, etc., the average price of lake copper in January 1915 was 13.89 cents per lb.; in December 1915 it was 20.37 cents per lb. The price of pig tin January 1915 averaged 34.3 cents per lb., and in December 1915, 38.75 cents per lb. This metal reached a price during the year as high as 57 cents per lb.

"The price of pig lead in January 1915 was 3.74 cents; in December 1915, 5.34 cents. During the interval it reached as high as 7 cents per lb. Spelter (zinc) was selling at 6.52 in January 1915, and in December 1915 the price was 16.91; in the interval it had gone as high as 22.6 cents."

This company state that the prices covering copper, tin, zinc, and lead have advanced still further during the present year; tin was as high as 55 cents per lb. a few days ago; copper, 28.5 cents per lb.; zinc-spelter and lead were also proportionately higher. This gives a fair idea of the trend of the metal market.

Very interesting figures have been furnished by another firm. This information is in the form of percentage advances. The items illustrated in the table below cover pretty fully the requirements of the average plumbing or heating installation:—

	Advance 1915 P.C.	Advance 1916 P.C.
Enamelled ware	..	10
Earthenware	..	12½
Soil pipe and fittings	..	22
Lead pipe	20	55
Lead traps and bends	20	40
Galv. range boilers	30	52½
Brass pipe	25	100
Iron pipe (black)	..	45
Iron pipe (galv.)	..	60
Iron pipe fittings	10	45
Compression work	10	33 1-3
Brass valves	10	50
Iron valves	7½	30
Radiators	12	22
Heating boilers	7½	17

(To be continued)

The average strength of Douglas Fir stringers, subjected to a process of creosoting involving boiling under vacuum and resulting in the removal of 35 per cent. of the total moisture in the specimen, has been shown to be approximately five-sixths of the original strength, compared to a one-third decrease with other processes.

Messrs. Peden & McLaren, architects, have moved from 20 St. Alexis Street to 54a Beaver Hall Hill, Montreal.

The Use of Oil as a Dust Preventative

Methods of Treating Road Surfaces With Asphaltic Oils as a Cure or Prevention of Dust. Some Cost Figures

By W Huber, A. M. C. S. C. E.*

The problem of dust prevention on rural roads has become acute only since the advent of the automobile as a serious factor in transportation. Prior to that time neither the nature of the traffic nor its speed was such as to cause serious inconvenience to travellers on the roads or the inhabitants along them. It is not to be denied that the deterioration of properly constructed stone roads before this time was due in a large measure to the formation of dust, but it was not nearly so rapid as it has been since the use of automobiles has become general. It is now generally admitted that if the formation of dust can be prevented, by removing the causes of this formation, the life of the road will be increased, to say nothing of the added comfort and convenience to the users of the road.

Dust

Dust may be defined as the detritus resulting from the abrasion or pulverization of the material composing the road surface. It may result from a number of causes, including the grinding and pulverizing action due to the impact of horses' feet and vehicle tires, the shearing action of self-propelled vehicle wheels, the physical actions of rain, frost and wind, the chemical action set up in the weathering of stone, and, usually most important of all, internal attrition or the grinding together of the individual stones of which the surface crust is composed. Of all these agencies, only the last mentioned is preventible; protection against the others consists in minimizing their effects.

The term dust as applied to roads usually implies such of the material as is raised from the road and blown about, and the objectionable features of the dust situation are largely in this connection. If it were possible to confine the dust to the road surface it would act as a cushion between the road and the traffic, and protect the road from many of the agencies tending to its destruction. The annoyance caused by the clouds of dust now lifted and transported from the road would be eliminated, and the dust would be a benefit to the road rather than a nuisance. As it is, the dust generated on many heavily travelled roads is so offensive as to make driving along them or living near them, unpleasant and unhealthy, and to render unfit for use the products of fields and orchards adjoining them. Apart then, from the increased life of the road and the decreased cost of maintenance there are other benefits resulting from the suppression or prevention of dust, and these benefits are most felt by those who come into daily contact with the roads.

Suppression of Dust

All being agreed that the prevention of dust is very desirable, the means by which this object may be accomplished may next be considered. The problem of the selection of suitable dust preventives and the most economical and effective employment of such materials as are chosen, form one of the most important subjects of modern highway engineering practice. Not only must the formation and dispersion of dust be prevented, but such methods must be employed as will give the greatest returns for the money spent. As the benefits of many of the methods of dust prevention in common use are of a temporary nature, it follows that before any comparison can be made, the items of cost of treatment, life of results, and effectiveness in dust prevention must be carefully considered in their relation to each other. Generally speaking, for a given finished road surface requiring treatment, the material and the method of application which will maintain it in as nearly a dustless condition as possible at the least cost per square yard per annum, is to be chosen.

Cure and Prevention

There are two methods by which dust may be prevented from rising, which may be classified respectively as cure and prevention, firstly the application of such substances to the road surface as will hold down the dust formed, and secondly the employment of such methods and materials in construction, or the treating of the finished road surface in such a way that the formation of dust will be reduced to a minimum.

The first method consists of applying various liquids such as water, salt solutions, light oils, light tars, and oil and tar emulsions, to the road, the particles of dust being held together by the surface tension of the liquid. Benefits resulting from thus treating the road are only temporary, and repetitions of the treatment are necessary at intervals depending on the character of the liquid, the condition of the road surface, the nature and intensity of traffic, etc. Water has long been used as a dust layer, but its rapid evaporation, and the comparatively high cost of obtaining continuously satisfactory results render its use on country roads both unprofitable and unsatisfactory. Granulated calcium chloride has been used as a dust preventive for a number of years, and under certain favorable conditions, has given excellent results as a temporary dust layer. It is purchased in the powder form and is applied in the dry state or in solution. Its dust-laying qualities depend on its ability to absorb and hold moisture from the atmosphere, thus keeping the road surface constantly moist. In humid climates its use is attended with considerable success, but in dry localities subjected to little rain, and a dry atmosphere, additional sprinkling with water will frequently be necessary.

Oils and Tar

Emulsions of oil and tar have been used to a considerable extent as dust layers. In the process of classification the oil is treated with some alkali or other saponifying material, which renders it capable of mixing with water. In this way the oil may be diluted and applied to the road in small quantities, at the same time covering the entire surface. Results of such treatment are, however, not lasting, and several applications per season are required. Light oils having either a paraffin or asphaltic base are also used for dust laying, their benefits also being only temporary, the length of time during which an application will retain its effectiveness depending on the factors mentioned.

The foregoing materials for dust prevention are now giving way largely to the use of heavier asphaltic

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oils, which, in addition to their dust-laying properties, contribute to the bond of the road. The asphalt, which is usually from 40 to 60 per cent. of the total, remains on the road and penetrates the surface to a certain extent after the volatile constituents have evaporated, and assists in binding the surface. With a good grade of asphaltic oil, on a moderately travelled road, one or two applications per season will usually suffice, and later applications, owing to the retention of a part of the oil on the road may be made lighter than the first.

The value of an oil as a dust preventive is gauged largely by the quantity and quality of the bituminous base retained by the road after the evaporation of the volatile parts. The base of mineral oils used for this purpose vary from almost pure paraffin to almost pure asphalt. The paraffin in these oils has no value as a permanent binder, and oils containing a pure paraffin base or one containing a relatively high proportion of paraffin to asphalt, are used only as temporary binders or dust layers. The asphaltic base is, however, a true binder, and each application of oil containing an asphalt base provides the road with a certain amount of real binding material. The lightest grades of refined tar are also used extensively in the surface treatment of roads. In the case of these materials there is also a certain degree of penetration into the road surface and the results of such treatment may be considered as partially permanent.

For best results and lowest costs in dust prevention and road preservation it is necessary to start on a well-built road. Thorough consolidation and binding of the stone will prevent the internal movement which is so productive of dust, while a good crown will shed the water which would otherwise lie on the surface and soften the stone, making the work of attrition by traffic so much easier. First-class construction is the first and greatest essential as a basis for efficient and economical maintenance.

Sweep Before Oiling

The practice of applying oil to a thick coat of dust on a road surface, while affording temporary relief, is not economical financially nor will it yield satisfactory results. A small application of oil to the dust will keep it down only until the traffic has brought the dry dust to the surface, while the use of sufficient oil to hold down the whole layer of dust will entail unnecessary expense, and worse still, will produce a surface with objectionable features almost, if not quite, as bad as those of the untreated dust. In wet weather the dust, oil, and water will churn into a most offensive and injurious mixture that will indelibly soil any clothing, carpets or other textile goods with which it may come in contact. In commencing the oiling of a stone road the dust should be removed as completely as possible. Not only swept off the road, but in cases where it is liable to be blown back it should be carted away. For the purpose of cleaning the road of dust preparatory to oiling, a horse-drawn rotary sweeper which may be purchased at a cost of about $275 is almost indispensable. The actual cost of sweeping is very little, and will soon be repaid in the saving of oil and the better results obtained.

Oil the Second Season

Oil must never be applied when the road is wet or even damp. An almost insignificant amount of moisture on the surface will prevent adhesion between the oil and the road and failure is sure to result. Neither should oil be applied to a newly built macadam road until the stone has become thoroughly set. While protecting the road after setting has taken place, it appears to retard this setting when applied before it is complete. Best results are frequently obtained from leaving the road to thoroughly harden during the first season and commencing the oiling during the second. Whenever possible oil should be applied in warm weather. Whether the oil is heated or not, the heat of the road will increase its fluidity and permit greater penetration. When applied during cool weather it thickens on the road surface and is picked up by vehicle wheels and horses' feet, and its benefits are largely lost.

Penetration into the road surface is one of the most important factors in road oiling, and all means should be adopted to assist it. After the oil has been applied the road should, if at all possible, be closed to traffic for several hours in order that this penetration may proceed undisturbed, and the maximum benefits derived from the oiling, with the minimum inconvenience to the users of the road.

Application

Methods of applying oil are numerous, the original one being that of sprinkling by hand with ordinary sprinkling cans. This method is slow, inefficient and wasteful of oil and labor. It is impossible to secure a uniform treatment without using more oil than would be necessary to obtain like results when the oil is distributed by mechanical means. Mechanical sprinklers are of two kinds, gravity and pressure. The gravity sprinkler is the more common, probably because the cheaper. For the lighter oils an ordinary water wagon with sprinkler attachment will serve. With the heavier oils and tars, a pressure sprinkler should always be used. The pressure sprinkler is usually operated by a pump driven by the axle of the wagon or truck carrying the tank, and the oil or tar is delivered in the form of a spray. The velocity at which the oil strikes the road assists the penetration and much better results are obtained than with the ordinary gravity methods.

Heating

Whether an oil will require to be heated will depend partly on its percentage of asphalt, and partly on the weather. On a hot day an oil containing as much as forty per cent. asphalt may be applied cold, but even when the oil will run freely, better results will be obtained by heating it. In heating oil, care must be taken not to overheat it. Specifications for the use of a given oil usually state the temperature at which it should be applied, and this temperature should never be exceeded.

Quantity Necessary

The quantity of oil applied should be carefully watched. An insufficient quantity will not accomplish the desired results, while too much is not only wasteful, but leaves a surplus on top which is harmful to anything it touches. The quantity should be such that the surface is completely covered, and no more. This quantity will vary with the fluidity of the oil and the condition of the road surface. On a smooth surface, from which the dust has been well cleaned, the amount required will be a minimum; with a light oil, the entire surface may be covered with an application of one-eighth gallon per square yard. It is hardly to be expected, however, that such an application will prevent dust for an entire season; several applications may be necessary, but the cost will still be reasonable, owing to the moderate quantity used at each application.

A light sprinkling of sand over the oil when first applied will take up any excess of oil and prevent it adhering to vehicle wheels, etc. When the oil has penetrated the road any excess of sand may be swept off. Costs of dust suppression with light oils vary between wide limits, owing largely to the indiscriminate manner in which they are frequently applied. On many country roads a single application of forty per cent. asphaltic oil will keep them fairly dustless for an entire season, at a cost of from one to one and one-half cents per square yard.

Disintegration of Bare Spots

In order to continue the benefits of road oiling, care must be taken to keep the surface covered. Bare spots must not be allowed to develop or pits will form.

Experience has shown that where the stone becomes bare, disintegration is more rapid than in the case of the untreated road. This is due to the fact that the oil has prevented the penetration of moisture to the road. In the case of an untreated road, the surface will absorb a certain amount of moisture which is necessary to maintain the bond. Proof of this is seen in the ravelling of many macadam roads during continued hot, dry weather. When oil is applied it takes the place of the moisture and the surface bond is maintained, and even improved. When the oil is worn from the surface, the stone beneath, robbed of its bond, will rapidly ravel, and a pit in the road is the result. The scheme of road maintenance should provide for a frequent and systematic inspection of all oiled roads and the application of a small quantity of oil to any spots where bare stone is showing.

Carpet Coat

The second method of dust prevention on finished roads is prevention in fact as well as in name. Whereas the materials already enumerated are more for the purpose of holding down dust which has already formed, the more effective plan aims at preventing the formation of the dust. This consists of covering the entire surface with what is known as a carpet coat of heavy asphaltic oil or medium grade tar, filled with stone chips free from dust. This results in a surface from one-eighth to one-half inch thick composed of stone chips and a bituminous binder, the object of the stone being to take the wear of traffic, and of the bitumen to bind the stone together and hold it on the road.

While more expensive than the application of light oils, the carpet coat is usually more economical in the end, since a single treatment will last several times as long. When properly applied a carpet coat of bitumen and stone chips may last, with a small amount of maintenance, for from two to five seasons, providing a road which has many advantages equal to those of a bituminous macadam road. In some respects a properly constructed macadam road with a bituminous carpet coat is to be preferred to one with several inches of bituminous-bound surface. The cost is less, being equal to that of an ordinary macadam road, plus eight or ten cents per square yard. The body of the road, if built on a firm subgrade is perhaps more rigid than the bituminous macadam, owing to the danger in the construction of the latter type of using an excessive quantity of bitumen. This is particularly true of country roads, where experience in the use of bituminous binders is not so extensive as in the case of city streets. If the road is systematically maintained, the only work and material necessary are those required for keeping the carpet coat in good condition, the correct practice being to mend any defects in the surface before the body of the road is injured. This follows the principle of maintenance of city streets, where the concrete base is considered permanent, and the wearing surface, of whatever character, is renewed as occasion requires.

Application

The successful application of a carpet coat depends on a number of things, among the most important of which are the thorough cleaning of all dust off the road so that the bare stone is exposed over the entire surface, and the taking up of all the bitumen with stone chips. The first condition is necessary to secure the adhesion of the coat to the road, while the second prevents the creeping of the carpet coat in hot weather and the consequent formation of lumps. Of recent years the tendency has been to apply the carpet coat as thinly as possible in order to prevent any danger of creeping. This is accomplished by using a somewhat lighter oil or a lighter grade of tar, which permits of distribution in a thinner layer.

In order to obtain best results, a warm day should be selected for the application of the bitumen. If the application is made in cool weather it will be found to have become cold and thick before it has had an opportunity to penetrate the road, and peeling will probably occur. Also, the stone chips used in covering will not go into the bitumen as they should, and much "bleeding" on subsequent warm days will result. The application is best made by means of a pressure sprinkler, which assists penetration by forcing the bitumen onto the road at a considerable velocity. Both horse-drawn sprinklers and motor-trucks are used for this purpose, the latter giving the better results, being more easily regulated as to speed and discharge, and covering the ground more expeditiously.

Adhesion to Old Surface

As results are to a considerable extent dependent on the degree of penetration, or at least on the adhesion between the bitumen and the road, it should, if possible, be left undisturbed for some time after being applied. This is where a warm day assists materially in the operation. On no account should any traffic be allowed on the road before the application of the stone chips. The bitumen will adhere to wheels and horses' feet, and when permitted, the results may usually be seen in the subsequent removal of that part of the bituminous coat which has been disturbed. Frequently, where such disturbance has occurred, the tracks of vehicles may be distinctly seen, several weeks later, in bare strips where the carpet coat has worn off or scaled off. Most of the bare spots which develop shortly after a road has been treated in this way are due to one of two causes: insufficient cleaning of the stone before application of the bitumen, or disturbance of the bitumen before it has had a chance to adhere firmly to the surface of the stone. If it is impracticable to keep the traffic entirely off the road, only one-half the width should be treated at a time.

The size of stone chips required will depend on the grade of bitumen used. For the heavier grades of asphalt and tar used for this purpose half-inch chips are preferable, while with the lighter tars and asphaltic oils, quarter-inch stone or coarse sand will give better results. Whichever size of stone is used it must be free from dust. As the stone chips or sand is to compose the actual wearing surface of the road it must be carefully selected and as carefully applied. Wherever obtainable at a reasonable price, trap or granite chips should be used. First quality limestone is next in preference, while pea gravel and coarse sand, if of good quality, may also be used.

Oil Content

Considering first the application of the heavier oils and tars to road surfaces, the bitumen is distributed at the rate of one-third to one-half gallon per square yard, and after allowing it to penetrate to as great an extent as possible, half-inch stone chips are spread over the entire surface, in quantity sufficient to provide a layer from one-third to one-half inch thick. Since the success of the treatment and the prevention of creeping depend on the consolidation of the stone, it must be rolled, and warm weather during the period of rolling is of great assistance in obtaining a maximum consolidation. During the process of rolling the stone is forced into the bitumen, which comes to or near the surface. The principle on which the rolling is done is that the voids in the stone shall be reduced to a minimum, and these voids be filled with bitumen. If the voids are not as small as possible there is an excess of bitumen which will come to the surface and cause "bleeding" of the road in hot weather, when, assisted by the crown of the road it will tend to run toward the sides and cause lumps. The roller should make several passages over each portion of the road, and fresh stone should be applied wherever the tar or oil comes to the surface.

In order that running of the bitumen may not occur, a number of conditions must be complied with. First, the bitumen must not be applied in larger quantities than just sufficient to cover the road. Care must be taken that it is heated to the correct temperature, else its viscocity will requirè a larger amount to be used than is necessary or advisable. Sufficient stone must be used to take up all this bitumen, so that no free bitumen will remain on the surface. Rolling must be thoroughly done in order to reduce the volume of the stone to a minimum, and the rolling must take place before the road has cooled to such a degree that the bitumen will not flow freely between the particles of stone. If work of this character is done in cool weather the surface is almost sure to run and bleed badly in ensuing hot days. If the foregoing precautions are observed, a satisfactory surface should result, with creeping eliminated.

Cost

The cost of a heavy carpet coat such as described will usually be from eight to ten cents per square yard, and the life of such a coat, with careful though not expensive maintenance, is estimated at from two to five years. Including the cost of maintenance, the annual cost of this form of road protection in ordinary cases will be from two to four cents per square yard. The cost will be somewhat increased on main travelled and suburban roads, in which case it may be as high as six or eight cents per square yard per annum.

As the tendency to creep depends largely on the thickness of the carpet coat, and as this tendency constitutes one of the main objections to this form of road preservation, recent practice has changed somewhat to a preference for a thinner coat composed of a lighter grade of asphaltic oil or tar, filled with smaller stone chips or coarse sand. The durability of such a treatment is not nearly equal to that of the heavier carpet coat, but the lower cost at which it can be applied will permit of more frequent re-surfacing. It possesses the additional advantage that rolling is not absolutely necessary, and the cost of this item may be eliminated.

The cost of the latter treatment, using approximately one-quarter gallon per square yard and covering with sand is ordinarily from three to four cents per square yard. With ordinary country road traffic this treatment will last a full season, and in most cases a moderate amount of repair work will make it good for a second, making an average cost of from one and one-half to three cents per square yard per season, or somewhat less than the usual cost of the heavier treatment.

The Increasing Use of Electricity

The Electric Road Roller in England Proves to be Cheaper, Cleaner and More Economical than Steam or Gas Rollers

By A. Jackson Marshall

The subject of electric road rollers is one which has had but slight consideration in this country. England, more keenly alive to the possibilities of electricity as a motive power than ever before, has favored the electric vehicle for municipal service in many and varied ways, and an eminent English engineer has published in a recent issue of the London Electrical Times an account of his investigations and study of the feasibility of the electric road roller. England is growing accustomed to the electric vehicle and finds it satisfactory. That it is an ill wind that blows no good is quite applicable to the electric truck situation in England at the present time, and while horses and gasoline trucks during the early part of the war were commandeered in great numbers for transport service, electric truck installations have been greatly increased and many concerns that had formerly employed either horse or petrol equipment, have come to realize the superiority of electricity as a motive power for vehicles used in urban delivery and trucking industries of all kinds. With the cost of gasoline always high and now rising to prohibitive prices and the drastic measures which the English government has taken to prevent the gasoline supply from being entirely exhausted, it is reasonable to expect that England will turn to the electric vehicle which is dependent for its power on the great natural resource—England's inexhaustible coal supply. Municipalities have been forced to recognize the economy, simplicity, ease of operation and cleanliness of the electric and the result has been the adoption of this type for many forms of municipal service. As a result of the action taken by the board of health of the City of Manchester to forbid the maintenance of stables in urban areas, electric vehicles have been adopted in the place of horses in several branches of municipal work. Electric omnibuses, electric fire apparatus, electric vans for the collection of refuse, electric street sprinkling carts are all very extensively used in England already and now comes the electric road roller.

Increased Use of Electricity

During the past decade many material conditions have changed, though in every respect they are favorable to the utilization of electric road rollers in city and town areas. One of the changes is the greatly increased use of electricity, and another is the improvement of all common roads resulting from the increase of power propelled vehicles. Naturally in congested areas the unit stress on pavement is more acute, while the business aspect calls for a much higher degree of engineering capacity than that entailed by rural highways. Before 1865, when the steam roller was a nine days' wonder in Paris, horse rollers had been used which were for many reasons quite unsatisfactory. In 1869 and 70 the first discussions on the steam roller took place in Birmingham, England.

Weight and Speed

The pressure per square inch imposed on the road surface by the weight of the roller must, with water, be greater by 25 per cent. than that of the heaviest vehicles using finished roads. Where a 30-ton steam roller supplied this condition, the effect with water lubricant was to unduly crush the metal. With a 15-ton roller this destruction did not occur, but the pressure was insufficient. As a lubricant and binding agent, bitumen has modified very considerably these considerations.

The speed of rolling should not exceed 2.5 miles per hour, and the horse-power, for which no indicator diagrams seem to be available, appears to be roughly one horse-power per ton gross. If the commercial efficiency of an enclosed traction electric motor is taken at the convenient figure of 74.6 per cent., then for a 15-ton roller a 15 horse power motor equipment would require a specific discharge rate for its accumulator (storage battery) of 15 kilowatts. The weight of the battery carried by any vehicle, states the Electrical Times, depends upon the specific discharge rate of the cells employed. But in this case the ten hour rate favored by battery makers fits in with a ten hour working day favored by road roller attendants.

Today the first demand is for an 8 and 10-ton roller for bituminous work, particularly for a roller with short road base for transverse work and patching. Such a roller, if electrically operated, can stand and charge all night. It can be worked with one attendant with the utmost simplicity and the minimum of effort. At any time it is ready instantly to go out to its work, without that one hour to get up steam which is necessary for a small steam patching roller, and it can be designed to travel at a good speed when running from job to job over normal roads where traffic resistence is lower than upon the actual work.

Battery Capacity

Allowing for a minimum discharge at a ten-hour rate and a maximum, when rolling upon hills, at a three hour rate, an equipment of .75 kilowatts per ton is estimated. As the roller advances and oscillates over a given piece, there is a point of stop and reverse. This point has puzzled the steam roller makers and led them to produce at great pains a quick reversing link motion or other similar gear, whereby the halt at the change of direction may be reduced to the minimum. On this point electric control is especially favorable, and the point is most important because undulations form in the roadway where these halts have occurred. In electrical working, it is possible to cut off the current and allow the roller to decelerate while the motor has been switched to that connection which has changed its direction of rotation and started it to accumulate its effort in the reverse sense, all ready for an instantaneous reverse movement.

Even Surfaces

Because of the tendency to the formation of undulations or corrugations which develop later in traffic, due initially to these halts and reverses in rolling, three rolls in tandem have been advocated, instead of the time honored two side rolls and one center leading roll. In addition to this, the halt point, which, with a good operator should not be a repeated point, should also be varied by different pressure upon the three, or upon two rollers. Thus the unit downward pressure upon the leading roller would be appreciably lower than upon those succeeding it. This can of course be easily arranged in the design.

For city work neither steam nor gasoline propulsion could compete with the electric automatic road roller. All automatic controls undoubtedly increase efficiency and precision. The electric road roller lends itself to automatic control. At the same time automate control is likely to be a strong feature in urging common adoption of electric rollers. With steam and gasoline there are other inherent complexities, and automatic controls cannot be nearly so simple as in the case of electricity. The real reason, however, why automatic rollers have never been proposed is probably that only in the case of electric road rollers is the attendant not required continuously on the vehicle for purposes other than running control. Once the simplicity of electric driving and control is considered there follows naturally the simplicity of various means of setting the reversal distances and cross feeds, and the automatic road roller, with its obviously higher efficiency than with hand-feed and control, is the progressive result.

Advantages of the Electric

In addition to a type of electric roller weighing eight or ten tons, there is a demand in most cities for a four to six ton type. The latter would almost certainly be a one-man machine equipped with suitable materials as well as with heating and mixing trays and spraying devices, all complete for the repair of those numerous holes and ruts of one square foot upwards, which automobile drivers discover to their cost in every part of the road. There are few towns that would benefit markedly by two or three of these one man electric automatic repair rollers dressing continually the small pot-holes in the streets which are so injurious. These four ton rollers would be of about the same weight in the frame as the eight ton type, but lighter all around in the cells, rollers and motors.

On the whole there is no doubt that the low speed of rollers and short radius of service within a given area favor electric cells and propulsion. There is every evidence now of a demand for electricity in England to supersede steam and the more modern gasoline and oil types of road rollers. It is not a question of first cost of plant, or of operating costs, for modern cities are prepared to pay without exception, even should there be an increased charge, for healthful improvements and silent workings and cleanliness, to say nothing of more uniform wear after automatic rolling. Electric road rollers constitute an improvement over and an advance upon the noisy and dirty working of steam rollers.

Troubles in the Engineering Profession

Stricter Qualifications to Protect Both the Public and the Qualified Engineer from the Quack

By G. N. Houston, M.C.S.C.E.*

There is a growing tendency among certain engineers to attempt to remedy some of the troubles in the engineering profession by means of legislation, limiting those who can legally practise to engineers having certain qualifications.

The reasons advanced for advocating the licensing of the profession come under two classes—self protection and public protection.

Self Protection

We are all familiar with the Rodman, who having been endowed by nature with a vivid imagination, a superabundance of self-confidence and a glib tongue, hires an office, hangs out his shingle, fakes his experience and poses as a consulting engineer.

Should not the competent engineer be protected from this class of fakers? Doctors, lawyers and even school teachers are required to have certificates before they can practise. Why not the engineer?

The only grounds upon which we should ask the public for legislative control of the engineering practice is that of public protection. The public need protection because they are not in a position to judge of the ability of an engineer.

An engineer's ability must be inferred from either his education, his works or his membership in the strictly engineering societies.

Experience Necessary

If the problems of engineering design, construction and operation were merely matters of figures the man fresh from college would usually qualify as the best engineer. Many men leave our institutes with this view but soon find that long before the time for applying formulae is reached the scheme must be viewed by an engineer of sound judgment based upon long experience.

Diplomacy, tact and good judgment are so essential in all engineering operations that any attempt to judge an engineer by mere degrees and diplomas is likely to prove a failure. Can the public judge his ability by his works? Unfortunately popular descriptions of engineering works do not find their way into the public press except occasionally and the public does not read the engineering press. An engineer's works do not always indicate his ability. A badly designed bridge may stand for years a menace to the public and finally go down when the critical load comes on it. A dam may stand until a flood comes. It takes time to demonstrate the ability of an engineer by his works. Membership in Engineering Societies should be a good criterion by which to judge the ability of an engineer. In other words how does he stand in the profession? What do his associates think of him? They are in a far better position to correctly estimate his ability than the public in general.

Licensing Engineers

The Committee of the American Society of Civil Engineers, appointed to consider this matter, while reporting against the general principle of licensing engineers, realized that there were many engineers who favored the idea and that many very inferior acts had been drawn up and submitted to the law making bodies for enactment. Should some of these pass, licenses would be issued to men totally incompetent, thus deceiving the public instead of protecting them. The Committee, therefore, draughted a Model Bill to be used as a basis for proposed legislation. The Acts which have been proposed come under two classes.

(a) Those which attempt to license all in the profession.

(b) Those which apply to engineers practising only in certain lines.

Many difficulties are encountered in draughting an Act. The first trouble comes in defining to whom the Act applies. Especially is this true under the first class of bills.

In the Colorado Act submitted to the Legislature in 1910 the definition of the Civil Engineer was very broad.

Civil Engineering Defined

In 1914 the proposed definition of Civil Engineering was modified as follows:—

"The profession of Civil Engineering, within the meaning of this Act, embraces the design, inspection and supervision of construction, and reports on the safety, of public or private utilities which require experience and the same technical knowledge as engineering schools of recognized reputation require for graduation; provided, however, that none of the provisions of this Act shall apply to the practice of surveying, and, provided further that the provisions of this act shall be limited to the services of engineers in the design, inspection and supervision of construction, and reports on the safety, of any structure or works on any of the following kinds or classes of structure and works.

1. Bridges 16 feet or more in length or other structures requiring a determination of stresses and strains for their proper design, on public highways or roads open to the use of the public, or on steam or electric or other railroads.

2. Structures built of stone, plain concrete or reinforced concrete.

3. Structural steel structures including steel in buildings and similar structures when said buildings or structures are three or more stories in height, also steel in mill buildings, steel in grain elevators, steel in mine and mill structures, steel in industrial buildings, and steel in plants and steel in structures on ditches, canals, sewers, waterworks and power plants.

4. Canals, ditches and conduits having a capacity of fifty cubic feet per second or more.

5. Sewers and sewer systems and sewage disposal plants; water supply plants for domestic use, and power plants including power plants for irrigation.

6. Dams and reservoir embankments of a height of ten feet or more.

7. Mill and power plant buildings of timber, brick,

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Abstract of an Address before the Calgary Branch Can. Soc. C. E.

concrete or any combination of these materials and electric transmission lines.

8. Timber bridges, trestles or structures for mill, mine and industrial plants, grain elevators, ditches, canals, sewers, waterworks and power plants.

9. No maps, plans, designs, reports, statements or filings to be certified or approved by an engineer shall be accepted or filed by any State official unless the certification or approval is executed by a person duly licensed in accordance with the provisions of this act.

It is a serious question whether a license law really excludes the incompetent man from the profession. There are quacks still practising in the medical profession and incompetents in the legal profession in spite of the Acts governing the practice. It is suggested that strict government supervision of plans, specifications and construction of all structures where the safety of the public is involved, combined with laws requiring a high qualification for engineers at the head of the departments, will result in a more effective public protection than any legislative attempt to control the engineering practice.

The qualifications for the heads of departments requiring engineering knowledge should provide for (1) a minimum residence in the country, province or state in order to ensure familiarity with local conditions. (2) Membership in one or more of the three National Engineering Societies—Can. Soc. C. E., Am. Soc. C. E. or British Institution of Civil Engineers. The requirements for admission to the grade of Member in all of these Societies are high and the tendency is to stiffen the requirements. (3) A minimum amount of experience in the particular line of engineering, a knowledge of which is required in order to fill the position. The above suggestion has greater possibilities in it for public protection than any system of licensing engineers. The proper method of handling the fake engineer is through the local branches of these national societies. His record can be investigated by them and shown up.

In addition to the above these local branches can do a considerable amount of advertising which would be considered unprofessional on the part of the individual to the end that the public may be kept in touch with engineering matters and be made to realize that membership in these societies represents high qualifications as an engineer.

ANGUS + ANGUS, ARCHITECTS,

New Eight Room Public School for Cochrane, Ont.

NORTH BAY & SUDBURY

In spite of frequently repeated statements that building is at a very low ebb, there are very encouraging evidences that many private individuals, municipalities, school boards, etc., are now going forward with work that has been temporarily delayed. This is no doubt due to a gradually increasing confidence in the outcome of the war, but even more, we believe, to the quite remarkable demonstration of Canada's stability, both financially and industrially, which has been so much in evidence since the war began.

A good example of this renewal of building, temporarily held up, is that of the public school in Cochrane, Ont. This was planned in 1914, architects were appointed, and everything was in readiness when the war decided the municipality to wait. The returning confidence is shown in the call for tenders which has just been sent out. This town, too, is itself typical of Canadian development, in that, though quite recently placed on the map, and known to most of us only by hearsay, an eight-roomed school building is being erected.

The school is approximately 96 by 65 feet over-all dimensions. The main exterior and interior carrying walls are solid brick; the construction is wood joists with bearings on steel or brick walls in every case. The exterior facing is red pressed brick with galvanized iron copings and cornices.

The foundation walls are concrete 20 inches thick, on 48-in. concrete footings. The basement floor and interior carrying walls to a height of 4 ft. are also concrete, the remaining walls being solid brick.

The building is two storeys and basement, laid

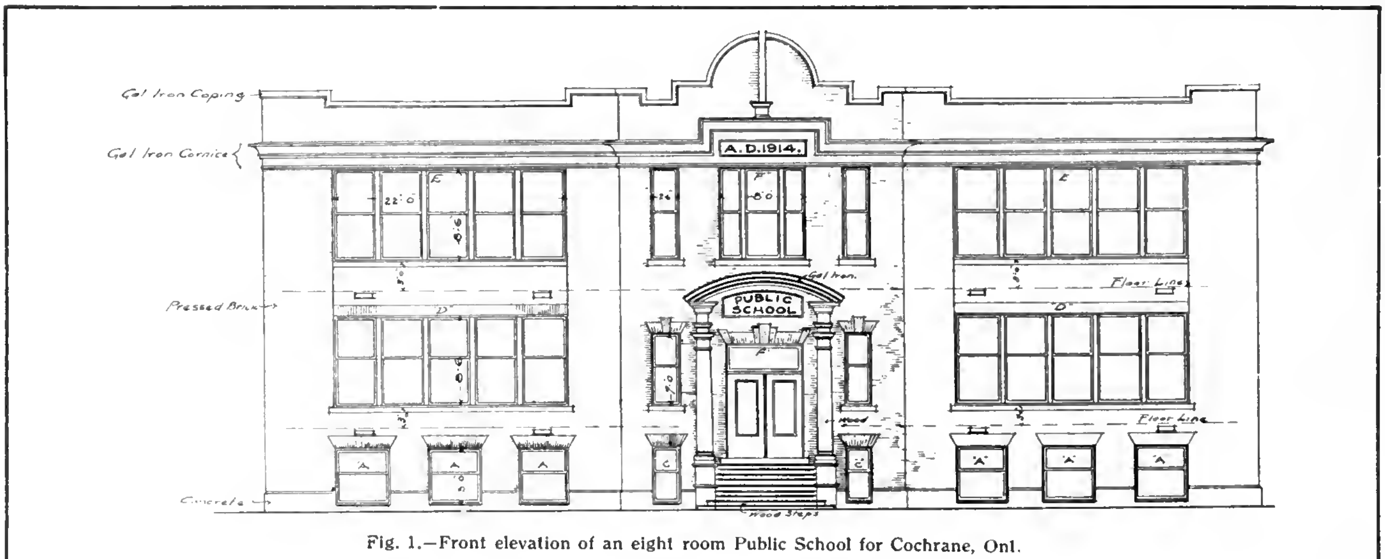


Fig. 1.—Front elevation of an eight room Public School for Cochrane, Ont.

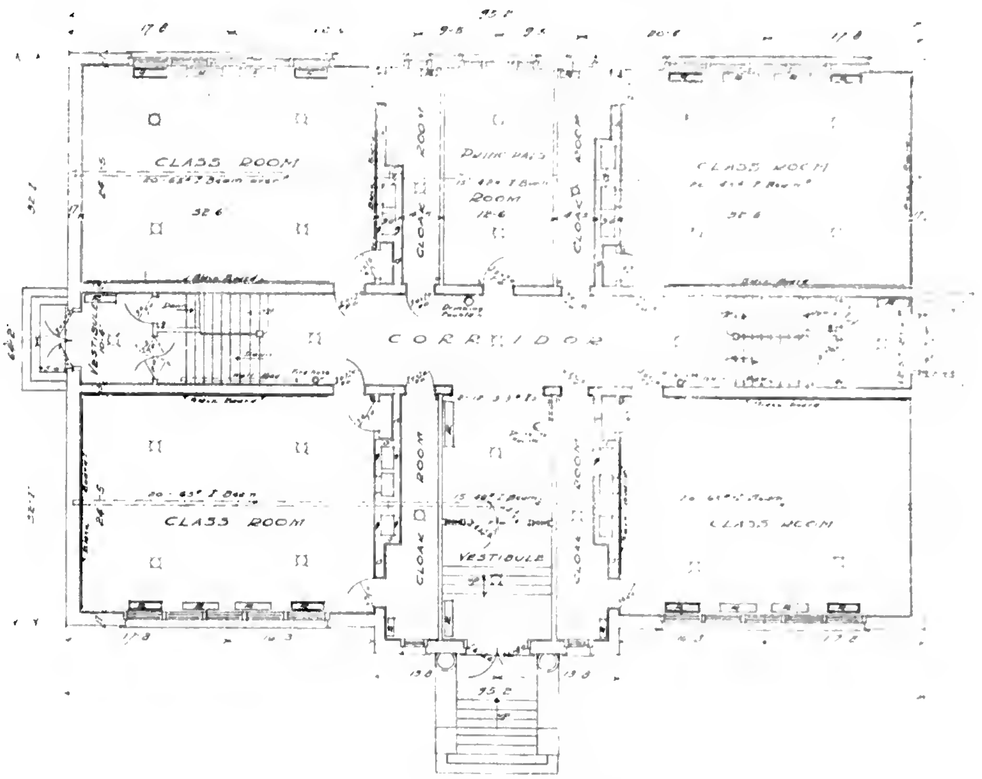


Fig. 2.—Ground floor plan, Cochrane School.

out uniformly with a main corridor on each floor across the building, with class-room in each corner.

The basement plan shows four large play-rooms, each approximately 25 by 33 ft., fuel room, boiler room with two boilers for the one-pipe, gravity, low-pressure steam heating, and the individual lavatories.

Wooden steps, a small portico surmounted with wooden pillars and a cast-iron coping, lead to the main entrance which opens into a large vestibule somewhat below the ground floor level. There are also two side and a rear entrance. The principal's room is directly opposite the main entrance, on the opposite side of the corridor. Four class-rooms 32 ft. 6 ins. by 24 ft. 6 ins., with separate cloak-rooms for each, account for the remaining floor space.

(Continued on page 391)

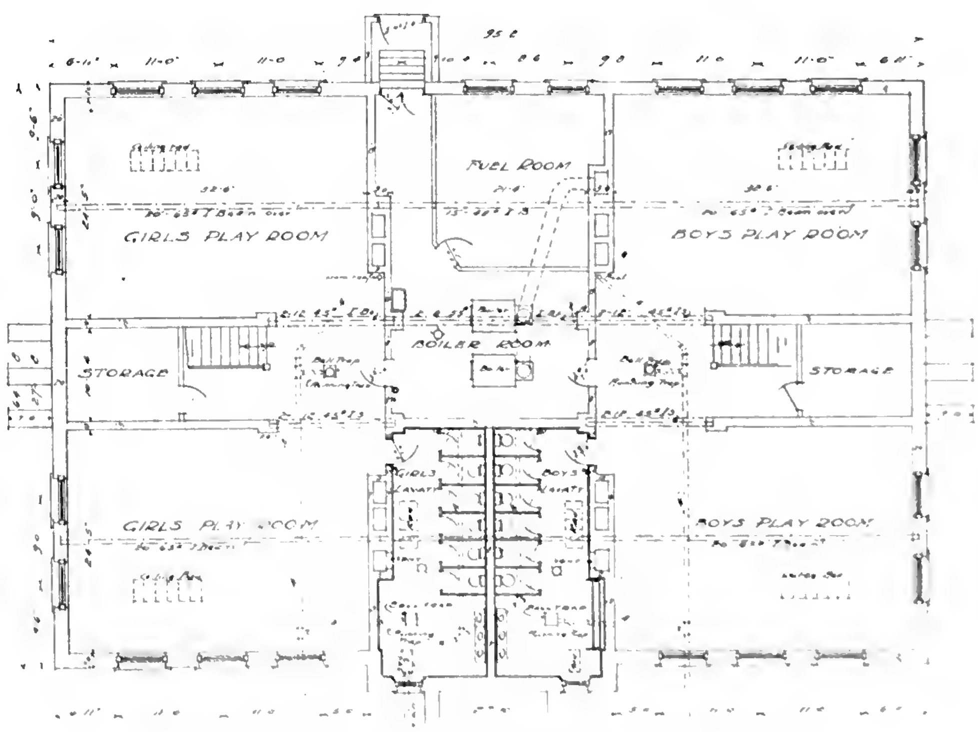


Fig. 3. Basement plan showing play rooms, lavoratories and heating equipment.

Sewage Treatment at Milwaukee, Wis.

Results of Two Years Exhaustive Practical Experiments on the Activated Sludge Process

By T. Chalkley Hatton

Exhaustive experiments on the activated sludge process of treating sewage to determine the best method of securing a uniform diffusion of air have been carried on at Milwaukee, Wis., for the past two years, under the direction of T. Chalkley Hatton and W. R. Copeland, of the Milwaukee Sewerage Commission. The following notes, giving a short summary of the process and the results of experiments, are abstracted from a paper by Mr. Hatton before the Illinois sections of the American Water-works Association and the Society of Engineers and Surveyors.

The plant has been equipped with the best apparatus available to determine the volume of sewage treated, volume and rate of air applied, and the making of the chemical and bacteriological investigations. It has been run continuously night and day, always with skilled supervision on duty.

Early in March of 1914 laboratory experiments were begun by using two glass tubes 6 feet long and 1¼ inches in diameter. At the bottom of one a filtros plate was inserted through which the air was passed and diffused. A small glass tube was placed inside of the other tube, and carried to near the bottom of the latter. Through this smaller tube the air was discharged from an orifice and diffused throughout the mixture of sludge and sewage contained in the large glass tube.

Experimental Plant

This experimental plant was erected and operated simply to secure information necessary to design a larger outside tank for trying out the process, and also to observe the difference of the effect of diffusing the air through a porous plate and open orifice.

The second series of experiments were conducted in a tank (improvised from a chemical precipitation tank), 32 ft. long, 10 ft. 6 ins. wide and 10 ft. deep, having a volume, when in operation, of 22,200 gals. In the bottom of this tank there are 51 filtros plates set in castings. The plates are 12 ins. square and 1½ ins. deep. The ratio of plate surface to tank surface is about 1 to 6.6. The coarse screened sewage is discharged directly from an orifice box (in which its volume is measured), in one end of the tank. The effluent is drawn off by means of a floating circular weir.

This tank was put in operation on May 6, 1914, and was continuously operated until November 24. Numerous variations were made in the cycles, volume and rate of air, but, under normal conditions, the cycle was as follows:

Filling 1 hour, aeration 3½ hours, settling ½ hour, drawing 1 hour. As soon as filling began the air was always turned on for the purpose of blowing the precipitated sludge off of the top of the filtros plate before the full head of water, when the tank was full, made the operation more difficult; thus the average aeration period was 3 hours only.

The third line of experiments was conducted in two inspection tanks 10 ft. deep, 5 ft. wide, by 1 ft. between sides. In each of the sides glass windows were inserted to permit of observing the action of the liquid during the several operations.

These experiments were conducted from June to the middle of November and gave us some very valuable information.

The fourth line of experiments was carried out to test the process by the continuous flow method. The tank used was the same size as, and built alongside of, the tank in which the second series of experiments was conducted by the fill and draw process. It was 32 ft. long, 10 ft. deep and 10 ft. 6 ins. wide. One-sixth was divided off at one end for the sedimentation chamber, and the balance was divided into a continuous channel about 3 ft. 4 ins. wide and 81 ft. long, at the bottom of which 42 filtros plates were set in castings, and air delivered to the underneath side of the plates. This tank was put in operation (after securing activated sludge), the first of August, and has been in continuous operation to date, with the exception of necessary shut downs due to the break down of the main sewage pumping station.

Many series of experiments have been conducted with this tank. The volume of air has been varied from 1 to 3 cu. ft. per gallon of sewage treated. The rate from 75 to 200 cu. ft. per minute. The rate of flow from 22,000 gals. to 74,000 gals. per 24 hours, or from 14 hours to a little less than four hours' running through period, and a great many observations made for controlling the sludge feed and the effects upon the process by varying volume of activated sludge.

The sewage treated has been taken from the main intercepting sewer serving a population of about 275,000, to which is added the liquid wastes from the packing house district, tanneries, breweries, and other large and varied industries.

Its average characteristics for the year have been as follows: 16.3 cu. yd. of solids per million gallons settleable in 2 hours; 259 parts per million of suspended matters, varying from 150 to 600 parts, 1,109 parts of total solids; 32.9 parts of organic nitrogen, 125 parts oxygen consumed; 2.2 parts of dissolved oxygen, and 1,461,000 bacteria per cubic centimeter at 20 degs. C. Temperatures have ranged from 44 degs. to 70 degs. F. The variation of flow and strength of sewage throughout the average week is approximately 82 per cent.

Air Diffusion

We feel that the best method of diffusing air has not been determined, although there are many available. As the use of this process becomes general this problem will no doubt be satisfactorily solved by progressive means.

The open air jet reduces the loss of air pressure, but reduces its efficiency owing to the size of the air bubbles produced. This objection may be overcome by reducing the size of the orifice.

Another objection we found to the open jet is its tendency to clog the air feed pipes with sludge drawn into the pipe when the air is shut off for any reason.

The monel metal cloth has only been tried out for about a month, and has proved quite satisfactory. Although, much more porous than the filtros plate, it produced smaller bubbles, due probably to the fact that the surface of the cloth was smooth and the air, while building the bubble, could not adhere to the surface as it does to the rough granular surface of the filtros plate.

Kisselghur was tried out. This gave the smallest bubble of any other agent tried, but the initial frictional loss sustained in getting the air through a plate ½-in. thick was 20 lbs., which made this diffuser impracticable owing to cost.

Filtros Plates

The filtros plates, if furnished of uniform porosity, have given the most satisfactory results, but they have a few characteristics which should be realized.

It is of the greatest importance that the agent used shall diffuse the air uniformly per cubic foot of liquor, therefore great care should be taken in getting a diffuser of uniform porosity. So far this has not been possible with the filtros plate. Out of 780 plates tested for our new 2,000,000-gal. plant, where we specified a plate which would pass 2 cu. ft. of air per minute under a 2-in. water pressure, and allowed a 5 per cent. variation either way, 35 per cent. of the plates received were rejected and only 27 per cent. came within the strict terms of the specifications.

Tests made with the plates used showed that when wet the initial loss of pressure due to passing the air through the plate under 5 lb. pressure was ¾ lb., and for every cubic foot of air per minute per square foot of surface passing the plate there was an additional loss of ¼ lb.

There are two ways of overcoming this great frictional loss, and the factor is an important one to consider in large plants. One is by reducing the thickness of plate to, say, ½ in., and reinforcing it with wire similar to window glass reinforcement; and the other is by soaking the plate, before use, in a mixture of paraffin and benzine, blowing with air until the paraffin appears at surface of plate. This establishes fine pores through the plate, which are coated with a non-absorbent, permitting the air to pass with the least friction and the paraffin impels the water so that the plate does not become waterlogged.

We have been operating filtros plates for nine months under all sorts of conditions, and have observed no difficulty in keeping the plates from absorbing the solids in the sewage, or becoming clogged on the underneath surface. It may be possible for the pores to become filled in time with bacterial growths, which may be removed by forcing heated air through them.

It is necessary, however, to filter the air before delivering it to the plate to prevent dust and dirt from reaching it. This is done by passing the air through a filter composed of excelsior built into the feed line.

The efficiency of the air varies almost directly as the size of the bubbles. We call the critical diameter ⅛ in. Below this size the efficiency increases very rapidly and the reverse is true for bubbles over this size.

There are three factors of special importance to be considered in choosing a diffuser agent. First, the smaller the air bubble produced the greater the efficiency. Second, greater density increases the frictional losses, and hence the cost. Third, the tendency to absorb and retain sludge, or to permit it to reach the underneath surface of the diffuser tends to reduce the efficiency of the diffuser, and allows sludge to precipitate on the top surface of the diffuser.

Functions of Activated Sludge

Activated sludge accomplishes four principal functions: The clarification of the liquor, removal of the putrescible organic matter, reduction of bacteria and finally, if the process be continued for a sufficient period, oxidizes the ammoniacal compounds into nitrates. Therefore, one of the first steps in designing a plant in which this process is to be employed is to determine the degree of purification required, following which the question arises as to efficiency, volume of air required, period of application and volume of activated sludge necessary to be kept in retention with the raw liquor.

Our problem in Milwaukee embraces the clarification of the liquor, securing an effluent stable for five days, the reduction of the suspended matters 90 per cent. and 95 per cent. removal of bacteria at 20 degs. C. With our continuous flow tank we have secured this average effluent for months by using 1.75 cu. ft. of air per gallon of sewage with 4 hours' aeration, 20 per cent. activated sludge and from 10 to 15 minutes' sedimentation period. Basing these results upon the operation of a 50,000,000-gal. plant, the estimated cost will be $4.38 per 1,000,000 gal., including all overhead and boiler room charges, but excluding engine room and plant attendance, and the cost of disposing of the sludge.

There appears to be no difference in the results obtained by carrying out the process either by the "fill and draw" or "continuous flow" methods considering volume of air applied per gallon, cost of aeration and volume of activated sludge required; but measured in terms of cost of construction and operation the "continuous flow" is the superior method. With a wide variation in strength of liquor and rate of flow a more uniform standard of effluent can be obtained from the "fill and draw" method because it is susceptible of better control, which is true of all "fill and draw" processes.

In order to maintain clarification and stability, and remove at least 95 per cent. of the bacteria from the Milwaukee sewage we have found it necessary to carry on the nitrogen cycle far enough to develop from 3 to 5 parts of nitrates. This has not been at all difficult to maintain.

Effect of Low Temperature

Low temperatures are not going to affect the process as much as we had anticipated. We believe, however, that the effect of such low temperature continuing over long periods may be easily overcome in one or two ways; either by adding more air, or a higher degree of activated sludge, or both. Thus the trouble can be overcome without excess tankage.

If more air is applied for a greater period, of course the nitrates are greatly and rapidly increased. This increases the value of the sludge. Whether this increase will pay for the additional air used is a matter yet to be determined.

The most economical ratio between diffusing surface and tank surface has not been definitely determined. Our ratios run from 1 to 5.0 to 1 to 8.5. There appears to be no appreciable difference in the results obtained. We are inclined to the belief, however, that a much greater ratio would reduce the efficiency by permitting more air to escape without giving the liquor the maximum opportunity to absorb it.

While all of our experiments have been made upon tanks holding 8 to 10 ft. of liquor, our supplementary experiments indicate that more efficiency of air can be obtained in deeper tanks by reason of the longer contact period between the air and liquor, and the tendency of the air, as it escapes from the diffuser, to break up into smaller bubbles because the pressure head upon it has been increased. Local conditions might, and probably would, largely control the depth of tank.

Volume of Air

The purification of sewage obtained varies decidedly with the volume of air applied. Small volumes applied for five or six hours do as well as larger volumes applied for three or four hours; but the time of aeration required to obtain a like effluent does not vary directly with the volume of air applied per unit of time. For instance, air applied at a rate of 2 cu. ft. per minute purifies the sewage in less time than 1 cu. ft. of air per minute, but will not accomplish an equal degree of purification in one-half the time.

There is also a limit to the volume of air applied per period of application below which it is not possible to secure any significant degree of purification. If less than 1 cu. ft. of air per gallon of sewage treated be applied for a period of four hours the degree of purification of the Milwaukee sewage rapidly decreases until little or none is effected; but, if the period of application is continued long enough, this rate of air will produce any degree of purification required.

In view of the fact that the air is the most important item of cost in the operation of the activated sludge process, we tried out many experiments with a view of determining the effect of decreasing the period of aeration and rate of application.

Data on Unit Quantities

Our experiments so far indicate that with 15 ft. deep rectangular tanks 15,000,000 gals. of sewage can be treated per acre of ground covered, which includes influent and effluent conduits, sedimentation and sludge tanks, and that the cost of such tanks, including influent and effluent conduits, pipe foundations and all piping, will be approximately $18,000 per 1,000,000 gals. This cost is based upon our local conditions where the tanks have to be built out into the lake and supported upon piles 40 ft. long with 4 ft. centres.

The sedimentation period required to reduce the suspended solids to 10 to 12 parts per 1,000,000 is from 10 to 25 minutes; the latter seeming to be a maximum with low temperatures.

We now come to the consideration of the sludge, and it is interesting here to describe how the percentage of activated sludge in contact with the liquor is determined.

We speak of maintaining a certain percentage of this sludge with the sewage during aeration, and in order to establish a unit which is easily determined we have fixed on that volume settling during one-half hour. It is true this is an arbitrary determination, but it is logical, nevertheless. From a great many determinations it has been found that 78 per cent. of well activated sludge will settle out of the mixture in one-half hour, and that during the next one-half hour the addition is but 4 per cent. It is desirable in operating the plant to determine frequently the volume of this sludge in contact with the liquor. One hour is often too late to get the most benefit from any change demanded. This sludge, so settled out, has about 98 per cent. moisture content, and it is desirable to return this sludge to the raw sewage with as little water content as practicable, because the more water the more tank area required.

To get this result it is necessary not only to let the sludge settle for at least one-half hour, but to put it under a pressure due to a head of water over it. In our new tanks we let the sludge from the sedimentation tank settle to the bottom of a 4-ft. chamber built under the tank 35 ft. deep, from whence it is pumped out after being compacted by a head due to 34 ft. of the liquor over it. Then it is further aerated in reservation sludge tanks, again settled, and pumped from the bottom of the second sludge settling tank to the raw sewage.

From our experiments we find that under a 26-ft. head of liquor the sludge will be de-watered in one-half hour from 98 per cent. to 94 per cent. and lose 40 per cent. of its volume. If a 94 per cent. rich activated sludge can be mixed with the raw sewage as it enters the aerating tanks, the size of these tanks can be materially reduced. By extra aerating the sludge to be returned to the raw sewage it is believed that the volume of air required to treat the raw sewage will be diminished. Thus the cost will be decreased because it will require only one-fifth of the volume of air to give this sludge the extra aeration (providing 20 per cent. of activated sludge is being maintained in the sewage tanks) as to give the whole body of sewage treated the same air treatment.

It has been demonstrated beyond doubt that the richer the activated sludge in nitrates the quicker the purification of the sewage and less air is required.

The sludge produced is quite brown in color, appears like pieces of finely divided sponge, and settles out of the quiet liquor very rapidly; 65 per cent. will settle in 10 minutes. It is readily drained on the ordinary sludge drying beds, requiring about one-half the time of well digested Imhoff sludge, but it acts quite differently. During the first hour the liquid drains through the bottom, the sludge gradually settling upon the surface seems to close the interstices of the bed and the liquid rises to the top of the sludge from which it can be titrated without disturbing the settled sludge.

With two days of dry, warm weather its moisture content will be reduced on drying beds from 98 to 82 per cent., and in two weeks the moisture will be reduced to 65 per cent.

The sludge seems to absorb the colloidal matter very rapidly. Highly colored liquor introduced into it will be decolored in a few minutes. It has no apparent odor. When well activated the sludge produced by the Milwaukee sewage contains from 14,000,000 to 18,000,000 of bacteria per cubic centimeter, from 5 to 6 per cent. of fats and total nitrogen in the form of NH_3 from 4.4 to 9 per cent. based upon 10 per cent. moisture. At the present market the value of this sludge when degreased and reduced to fertilizer, that is, dried to 10 per cent. moisture and ground, ranges from $10 to $20 per short ton.

The Milwaukee sewage produced on an average about 3,000 gals. of sludge per 1,000,000 gals. at 98 per cent. moisture. On the basis of 10 per cent. moisture it produces about ½ ton per 1,000,000 gals.

The cost of dewatering, degreasing and drying the sludge has not yet been definitely determined, but from a careful study of this question it is believed this cost will not exceed $6 per dry ton. Apparatus for performing this portion of the work has already been arranged for and will be installed in our new 2,000,000-gal. plant during the coming month.

General Conclusions

As far as we have progressed with our experiments upon the treatment of sewage by the activated sludge process nothing has occurred which indicates that the process is unreliable, unworkable or unduly expensive. We feel, however, that there are many engineering problems yet to be solved before the ideal plant can be designed. We cannot hope to solve all of these in the first plant built, but expect this to be done progressively as other plants are built and operated.

Roman Catholic School and Residence for Cote des Neiges, P. Q.

A contract for the construction of a boys' and girls' school and teachers' residences for the Cote des Neiges Roman Catholic School Commissioners has been let to Messrs. E. N. and U. Boileau, Montreal. The school, designed by Mr. G. A. Monette, architect, Power Building, Montreal, will be on a site on the Cote des Neiges Road, measuring 234 feet by 65 feet. The school proper is to be 162 x 65 feet, the residences for the teachers being situated one at each end. The building is to consist of a basement and three storeys. The exterior will be constructed of rustic brick, (supplied by the National Brick Company of Laprairie) and stone trimmings, on a steel frame; the foundations will be of concrete, with a Megantic granite base up to the first floor.

The three storeys will contain a total of 22 class rooms, each, on an average, accommodating 40 pupils. The school is to be separated into two sections, one for boys and the other for girls, and the division will be made by means of a terra cotta wall constructed through the centre of the building. There are separate entrances for each section.

The floors are to be of Seigwart concrete beams, covered with maple. The partitions of the class rooms will be of plaster over terra cotta, the interior finish being of red pine. Semi-indirect electric lighting is to be provided. The roof is of felt and gravel.

Arrangements have been made on the ground floor for a library and for administration offices, while on the other floors there will be the usual toilet accommodation. Each residence will have accommodation for 15 teachers. A large playground will be provided at the rear of the school.

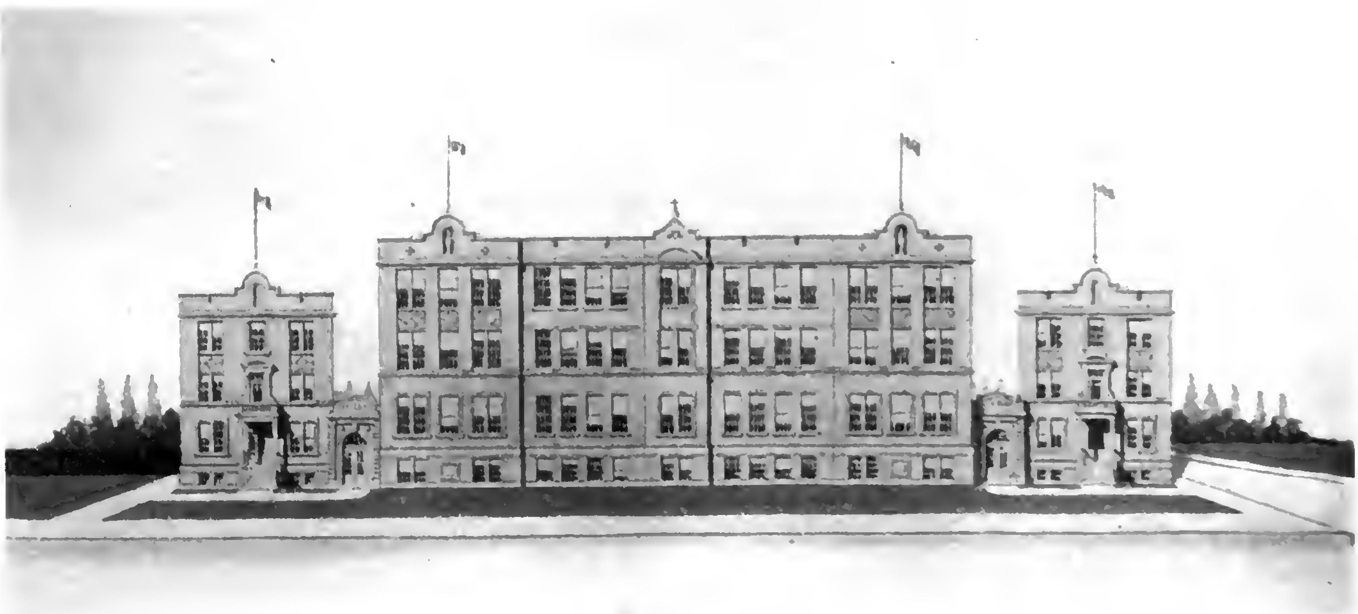
A recreation room and caretakers' quarters will be situated in the basement. In another portion of the basement, will be placed the equipment, including two boilers, for the steam heating, on the Dunham system; fans for the forced ventilation; and a vacuum system.

The following sub-contracts have been let: steel, Phoenix Bridge and Iron Works Ltd., Montreal; heating and ventilating, T. Lessard and Son, Ltd., Montreal; brick work, E. Rochefort, Montreal; cut stone, C. Piche, Montreal; plumbing, roofing and galvanized iron work, T. O'Connell, Montreal; tile and marble, Smith Marble and Construction Company Limited, Montreal; electric lighting, W. J. O'Leary and Co., Montreal.

Reinforced Concrete Failures

There seems to be a general impression that reinforcing rods stripped clean of concrete at a break in a reinforced-concrete failure are proof of green concrete. Investigators, in fact, are apt to take such a condition as primary evidence that the concrete had not set and to search for some cause that would explain such weakness. It is more than doubtful, however, that such an assumption is warranted.

The fact is that, under shock of collapse, steel tensile resistance or sufficient embedment will prove stronger than adhesion and that a firm, well-set concrete will strip clean from rods to which it has an adhesion far beyond that necessary for a proper transmission of normal stress.



Architect's Perspective, Roman Catholic School, Cote des Neiges.

Municipal "Clean-Up" Campaigns

Various Methods and Plans as Employed by U. S. Cities —Organization — Programmes — Benefits Derived (Conc.)

Sanitary Inspection

As a preliminary to the Clean-Up campaign in Kirkville, Mo., an inspection was made of all grocery stores, drug stores, bakeries, dairies, etc., by the State Pure Food Inspectors. The work continued over many months, and every Sunday one of the local newspapers devoted an entire page to the report of the conditions, good and bad. Each concern was scored on various points of sanitation on the basis of 100 per cent. perfect, and the Sunday paper printed the scores of all concerns inspected the previous week. Thus the interest of the public was roused to watch the scores. In the instances where the low scores were made the effects of public disapproval were instantly felt.

Flies and Mosquitoes

Swatting the fly plays an important part in the Clean-Up campaign of every community, and in nearly every city fly extermination literature is distributed during clean-up week. Bulletins, rubber stamps, fly traps, motion pictures, lectures, lantern slides, etc., everything available is used to depict the ravages of the fly. Fly extermination leaflets were sent to business establishments, to mothers' clubs, and post cards were sent to merchants whose places of business might be noticed to be fly infected. Boy Scouts distributed the literature and also reported as to stable conditions. Letters directed to business establishments, suggesting the use of fly swatters and traps as advertising material, were a further movement against the house fly. In Cincinnati a circular explaining the need of exterminating the winter fly was distributed through school children, and a marked reduction in the number of flies was secured. In 1915 a special general committee on fly extermination was named and became one of the most active factors in the campaign. Classes in manual training in the public schools made fly traps, the Public Library had prepared a complete set of lantern slides on fly extermination, and the committee had prepared and printed and distributed 50,000 circulars on the house fly and methods of extermination.

A rubber stamp with the inscription "Kill That Fly," together with the cut of a fly and a hand pointing in its direction was effectively used in the Cincinnati Clean-Up campaign. These stamps were so popular for use on correspondence and other literature that several lots were procured before the demand could be met.

The use of fly traps so effectively demonstrated, especially in the packing-house district and wholesale district during the 1915 campaign, that the purchase of a great many more and larger ones was urged for the 1916 campaign.

Ordinances

In some instances the Clean-Up movement has crystallized into an ordinance making it unlawful for any person to deposit on any lot or tract of land within the city limits, tin cans, waste paper, or rubbish of any kind.

In St. Paul the Health Department is empowered to clean up vacant lots when the owners fail to do so and assess the cost against the property.

Paterson, N. J., prohibits the dumping of refuse on vacant lots.

A Toledo ordinance prohibits the sweeping of sidewalks during the day, obstruction of sidewalks with tables and fruit stands, and the distribution of handbills.

The Los Angeles Weed Cleaning Ordinance calls for the removal of weeds from vacant lots in the spring and fall, and a request for a revolving fund of $15,388 has been made to the Council by the Board of Public Works. The ordinance provides that property owners must have removed from their vacant lots all weeds in the two weeks following the third Monday in April; otherwise the work will be done by the City and the cost charged to the property owner and collected along with the taxes. The ordinance also provides for a fall clean-up.

New York avoids a set time for Clean-Up by the provisions of its charter, which makes it the duty of the department to remove and dispose of light rubbish and refuse as often as the public health and the use of the streets require, and since this document was written public attention has been brought to the necessity for this work as fire prevention and thus has added to its importance. Because the materials are light and may be distributed over the streets the ordinance provides that all light refuse likely to be blown about the streets shall be properly wrapped, boxed or secured. Large cards such as are used for notifying express companies to call are placed in the windows and the rubbish cart calls at the door.

Waste a Source of Revenue

Tin cans and rubbish as a source of revenue must not be lost sight of. For instance, one city collected 37,000 tin cans which were deposited in the city dump. These cans might have been sold.

A Missouri city possessed but two miles of paved streets, which were a continual source of annoyance because they were not kept clean. The city possessed neither a sprinkler nor a cleaning system, and there was no money in the treasury for either. The women's clubs besought the merchants on these streets to turn over to them whatever funds they could spare to buy a sprinkler. This done, a second-hand sprinkler was bought. With extraordinary fore-sightedness the women noted the amount of dirt on the pavement, and so before turning the sprinkler on the streets sold $100 worth of the dirt and had the remainder carted to the low places that needed filling in in the cemetery. In this manner they utilized their foe for revenue.

Cost

The unit cost is almost impossible to obtain as most cities do not keep an accurate account of same.

Philadelphia removed 140,000 cubic yards of waste material at a net cost of 9 cents per cubic yard, and a gross cost—which includes every item of expense—slightly in excess of 12 cents per cubic yard, or 5 cents per family. One hundred and thirty-two dollars and forty-eight cents represents the unit cost per square mile for making 129 square miles of city area cleaner and brighter.

A tour through any city on the first day after

Clean-Up Week would convince the most incredulous that in promoting this movement the municipality had materially lessened the fire risk and made a marked improvement in sanitary conditions. Everywhere are heaps of waste materials and discarded articles, such as old bed springs, mattresses, sofas, glass, crockery, stoves, carpets, baby coaches, piled along the curb line.

The following are some of the results conceded worth while in most of the cities engaged in the movement:

A continuous campaign accomplishing permanent good.

Stimulation of business. (A canvass of the cities of the United States having clean-up campaigns resulted in the showing that 71 per cent. of the merchants were positive that their business had been increased.)

Improvement of housing conditions.

Distinct educational value for the young.

Prohibition of open garbage cans in some cities.

Sanitation in the handling of food products.

Better laws and methods in the disposal of garbage and rubbish.

Reduction in fire loss; thus reduction in insurance rates.

Elimination of unsightly lots and spots.

Hundreds of school gardens.

Renovation in most of the homes in a way they had never been renovated before.

A great reduction in the number of flies and mosquitoes.

A stimulation of civic pride and cleanliness and safety of the home.

A united effort by practically the entire population toward an end for the public good.

The education of school children toward a better idea of living conditions.

The razing of dangerous buildings.

Elimination of public dumps, prospective early elimination of many more.

Hundreds of new street litter cans.

Higher standards of the people for home and city.

Cleaner yards and vacant lots.

Distribution of thousands of fruit and shade trees.

Collection of combustible waste by Salvation Army, relieving Street Cleaning Department, and reducing dump evil.

Development of community spirit through united action in a movement for public welfare.

Safer, cleaner, healthier and more beautiful cities.

Recommendations for 1916

Special effort to devise some workable plan to attack successfully the problem of the vacant lot.

Special stress laid on the downtown section by organized effort of the residents and owners of downtown buildings.

Some organized effort to interest manufacturers.

Instruction of all inspectors.

Revision of city ordinances.

A "vigilance committee" made up of people with leisure time and who are willing to devote it to the campaign.

Uniform reports from schools.

Some methods to bring about better conditions on streets and alleys.

Greater effort toward securing the use of proper receptacles for garbage and rubbish, and the adequate removal of same.

Some plan for securing observance of the law for tenants as well as landlords of tenement houses.

The Schoop Metal Spray Process

Coating Surfaces of any Nature with any Metal, Demonstrated at University of Toronto. Paper read at McGill University

By T. Stanfield Worthington

A new process of coating objects of almost any nature, with any kind of metal, has recently been placed before the public in demonstration at McGill and Toronto Universities. The invention is not at all a new one, but is the culmination of years of research work by Dr. Max Ulrich Schoop, of France, an electro-chemist of international reputation. Solid particles of any metal are rendered molten, atomized, and projected on metal or other surfaces so that they form an amorphous part thereof rather than simply a thin covering which will wear off by abrasion, oxidation, or corrosion.

No surface of any nature whatever is too small nor too large to receive a coating of almost any metal, varying in thickness from 1/1000ths of an inch to as thick as may be desired.

As already stated, the process of spraying metal is not a new one; crude attempts had been made of applying metal to surfaces by pouring molten metal into a high-pressure jet of steam directed at the object. This process was very unreliable and inefficient, and was ultimately abandoned. Experiments with spraying hot metal, however, showed that adhered coatings were sometimes formed. These observations, together with those of the spreading and adhesive action of bullets fired at an iron plate, suggested a combined apparatus for pulverization and deposition which proved a vast improvement on previous processes. This apparatus is now in quite extensive use.

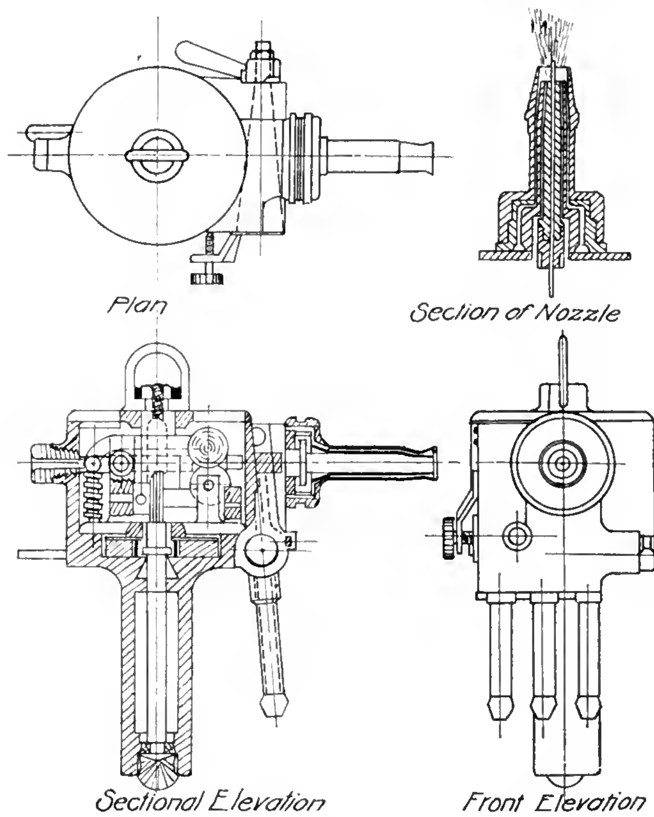
Apparatus

The essential parts of the machine, or "pistol," as it is called, are a combined melting and spraying jet, and a feed mechanism. The metal, in the form of rod or wire, is fed to the melting flame, which is formed by coal-gas, water-gas, acetylene, or hydrogen—burning in air or oxygen, according to the metal used. The gases are supplied at such pressures as to insure a highly de-oxidizing flame and yet prevent blowing out. The spraying jet is carbon dioxide, nitrogen, air, or steam, and is fed at such a pressure as to produce sufficient velocity for successful coating. The various pressures must be kept constant by accurate gauges and reducing valves. The feeding of the wire is accomplished by a small pneumatic motor, driven by the spraying medium, either in series or parallel with the main jet. The dimensions of the wire nozzle and feed mechanism vary with the different metals, and are so designed as to be readily interchangeable. For small work, hand operation is sufficient; but, when large work is undertaken, it is more convenient to have mechanical traverse and control.

To obtain the best adhesion, the surface on which the metal is sprayed must be thoroughly clean and of an open nature to give a key for the deposit. Sand blasting with sharp sand has been found best, shot giving too polished a surface. Such surfaces as fabrics, wood, unglazed earthenware, and asbestos require only freedom from grease, as their surfaces give a natural key. The mention of wood and fabrics as suitable substances to coat by means of an apparatus in which an intense flame is used may cause some surprise, which will be increased by the statement that celluloid, and even explosives, can be safely sprayed with metal.

Jet Design

With a given design of jet there is only a certain volume left by the air-jet which can be filled with flame, and this flame has a limiting temperature which



Plan, Elevation and Sections of "Pistol."

cannot be exceeded. The wire, passing through this cone of flame, is melted, partly by radiation, but chiefly by conduction. There is a definite limit to the amount of heat which can be picked up by the wire passing through the flame, and a definite limit to the rate at which it can be melted, which cannot be increased by forcing more gas into the flame, as the extra gas is merely blown away by the air-jet. It is possible to increase the rate of melting by shaping the nozzles so as to leave room for a larger cone of flame. There is, therefore, a definite and most economical quantity of gas which should be used in the pistol, this quantity being about 1.5 cubic foot of hydrogen per minute and 0.5 cubic foot of oxygen, or about 0.8 cubic foot of coal-gas to 0.65 cubic foot of oxygen for the present standard designs.

The outer jet performs a threefold purpose; it keeps the wire and nozzles cool, cools the object, and produces the requisite velocity. The velocity of the air leaving the jet will be independent of the volume discharged, and depends only upon the pressure at the jet, so long as there is no disturbance due to the entraining of air from the surrounding atmosphere. This, of course, will actually occur in practice, and the layer of air must have a certain thickness in order to prevent its being broken up and its velocity destroyed by mixing with the surrounding atmosphere. In addition to this the air-jet has to atomize the molten metal, and accelerate the particles up to its own velocity.

As at present constructed the standard pistol uses about 0.55 to 0.6 cu. ft. per minute for every pound per square inch of air pressure, so that with an air supply at 80 lbs. per sq. in., which is a very suitable figure for ordinary spraying, the air consumption will be from 45 to 50 cu. ft. per minute. The mass of this air will be from 830 to 920 grammes, and the mass of metal sprayed will amount to about 8 grammes in the case of iron to about 200 grammes in the case of lead.

Deposition

The action of deposition is probably a complex one. The minute particles of solid metal are driven with such force against the object that, in some cases, they fuse, but owing to their small relative size, are promptly chilled by the object to which they adhere. In addition, the suddenly chilled particles are possibly, or even probably, in the state of unstable equilibrium found in "Prince Rupert's Drops," and act like so many minute bombs, bursting on impact into almost molecular dimensions, and penetrating the smallest cracks and fissures of the object.

The process requires some care in manipulation, as, by varying the conditions it is possible to spray porous or non-porous coatings, and, with some metals, anything from a pure metal to a pure oxide. With care, however, non-porous, oxide-free, adhering coatings can be produced of almost any metal on almost any solid. In addition to metals, it is possible to spray fusible non-metals, or, by standard wires, alloys of metals, or mixture of metals, with non-metals.

Uses of Metal Spraying

The process is so new that its uses are still partly to be developed, but it is easy to see that it may have far-reaching value for protective coatings against weather or fire, for ornamental work, for electrical work, for the production of special alloys, for joint making, and for many other purposes.

Quite in a different category comes that of very fine casting. The surface of a pattern polished or slightly greasy is most minutely copied, and it is possible to produce process blocks very rapidly. It may also be useful to line molds before pouring in the metal.

The bulk of the work has hitherto been carried on in laboratories, but the apparatus is gradually becoming used in the more progressive factories where extended facilities, and the knowledge of specialized requirements, will insure rapid improvements in technique and results.

The Metal Coating Company of Canada, Montreal, holders of the Canadian patents on this process, gave an interesting demonstration of the process at the University of Toronto from April 10 to 15 inclusive. Many interesting specimens and samples of the process were on exhibit, and many practical operations were performed for the benefit of visiting business men.

Clay Qualities—Testing and Sampling

To Overcome Difficulties in Manufacture and Ascertain the Possibilities of a Profitable Business (Conc.)

By H. B. Henderson

The burning range temperature is most important. There are many clays and shales which will burn to a beautiful product at a certain temperature, but fail either above or below this temperature. A sample ware burned at this temperature might induce one to build a plant for the manufacture of the ware, but commercial operations would soon develop the fact that the material was impossible and the plant doomed to failure.

Limey clays often burn red at low temperatures, due to the iron content, but at higher temperatures when the lime begins to act, the iron is taken up with the lime to form a lime iron silicate, which has a buff green color.

A small amount of finely divided lime in a clay has no material effect, but as the lime increases in quantity it begins to get the limey color and short burning range effect noted in heat curves. Still higher quantities may act as a refractory and prevent the mass from fusing, but such very high limey clays will slake and crumble to pieces when exposed.

Gypsum (sulphate of lime) is frequently found in clays. It is the mineral which causes scumming, and any clay ware suitable for face building material should be tested for this trouble. Gypsum does not dissociate at low kiln temperatures and consequently may not act as a flux. When it develops as a white coating it goes through the fire unchanged, and the ware is unsightly in consequence. This is particularly true in oxidizing kiln conditions. Under reducing conditions, the sulphate breaks up and the lime content is set free to play the part of lime, and this may occur at a temperature when the ware may have nearly approached the failing point, and this additional flux introduced may be the last straw. When the surface is heavily coated with it, it may increase the density of the surface materially and cause increased shrinkage. If the ware has lamination the result would be to crack the surface and perhaps cause it to curl up and peel off.

Iron

Every clay contains iron in some form and in some degree, but any detailed discussion of iron in clay is far beyond the limits of this paper. Briefly, the iron may be present as a ferric (red) oxide, and it is to this that the red color is due; it may be ferrous oxide, or a carbonate, or a sulphide, or a constituent of some of the silicate minerals. It can be seen at a glance that its effect as a coloring agent will largely depend upon the state in which it occurs in the clay. As a red stain, coating each grain of clay, it would have the maximum coloring power. As mineral grains its coloring power depends upon the disassociation of the mineral at kiln temperatures and upon the fineness and distribution through the clay mass.

Usually, when in the form of a mineral other than the ferric oxide, a part or all of it passes into some other mineral form and it is lost as a red coloring agent. For instance, in the form of di sulphide (iron pyrites), when sulphur is driven off, the iron remains as ferrous oxide, in which form it is an active flux and readily takes up silica, lime, etc. If the kiln conditions are oxidizing, some of the ferrous oxide will be oxidized to the red oxide and serve to color the ware red, but a part, and the greater part, will be ferrous oxide which will combine with silica to form a black silicate. Such clays will first develop a red color from the free red oxide present, then become red-brown, the brown due to the effect of the black silicate, hence good color range may be very short and varying. As a red stain on the grains of clay, and without any appreciable amount of other iron minerals the red color may continue even until the ware is burned to glassiness. Iron carbonates will behave the same as the sulphides so far as color effect is concerned.

This again shows how futile chemical analyses are in determining the value of common clays, and also how important it is to determine the burning range which at the same time determines the color range. We may have beautiful ware at a certain temperature and there might be a safe burning range, but the color range may be very unsatisfactory.

Iron sulphide is frequently the cause of "popping." The little spot in the center of the "pop" will be red or black and will appear at a low red heat below cone 010 if due to iron minerals.

The danger from iron pyrites is dependent upon the quantity and state of aggregation. Thus, 5 per cent. of 20 to 40-mesh pyrites would not be noticeable in ordinary stiff mud products, while 5 per cent. of 16 to 20-mesh pyrites would cause some popping and where a grain happened to lie near the surface, a small fragment would fly off, destroying surface effect. If the quantity is large, as sometimes happens, the volume change of the pyrites may be great enough to burst the brick.

Iron, when in the form of pyrites, gives its greatest trouble in burning. The sulphur begins to come off at a low temperature, but it does not come off completely at any temperature, although the greater part of it can be roasted out before the clay becomes vitrified. Any sulphur given off after the mass becomes vitrified will cause blebs in the mass—bloated ware, familiar to nearly every clayworker. The swelling of ware in continuous kilns, which nearly every operator of a continuous kiln has experienced, is probably a sulphur trouble due to the sulphur gases of the kiln and not to the sulphur in the clay.

Magnesia is always present, usually in small amounts and gives no trouble. It may be in the form of a carbonate (dolomite and magnesite) or as a constituent of some silicate. Small amounts of magnesia are said to be beneficial as a flux, in that they produce toughness. In large amounts, we have found the material to have a short burning range similar to the behavior of lime. Magnesia, potash and soda in the form of sulphates cause efflorescence—the white scum which comes out on the wall after the brick are laid; indeed, it often appears on the ware in the piles on the yard.

Carbon

Carbon gives lots of trouble and if the clay is dark colored, the burning should be watched closely and a proper test should cover this feature. Carbon is a reducing agent, i. e., it takes oxygen from other minerals. Until the carbon is burned out oxidation of other minerals cannot take place and in their reduced condition they may be active fluxes. On the one hand, we have fluxes producing a vitrous impermeable body, and on the other hand, we have carbon and sulphur gases unable to escape as they develop, and instead, fill the mass with blebs which become larger and larger as the temperature advances.

Laboratories properly equipped have machines for the several processes which duplicate commercial conditions and are especially adapted to develop the difficulties in the clay. The laboratory machines are necessarily small and the results are largely dependent upon the experience of the operator and his knowledge of commercial operations. The tests, to be of value, must be practical, and a laboratory equipped with machinery for practical operations would require machines of all types and would be a greater institution than any factory, which is out of the question.

The point is this: Materials are sent in with the request that samples of sewer pipe, brick, stiff mud and dry pressed tile, hollow ware, etc., be submitted with the report. This is clearly beyond the province of a laboratory test. The laboratory test digs into the behavior of the clay in every stage of the manufacture and the tests are extreme in order to search out every weakness in the clay. All the products of the machines are subjected to subsequent tests which endeavor to destroy the product in order to determine the limits of the clay in every step of the manufacture.

Presentable ware is not practical in a laboratory test except the test be repeated under conditions in each stage which the real test has shown to be best. This subsequent work belongs to the manufacturer of equipment. The manufacturers of machinery are interested in the sale of such machinery and are prepared to make tests of clays in their machinery which will show how good a quality of ware can be produced. More should not be expected of them, and herein lies the cause of many failures. One cannot expect a manufacturer of equipment to go outside of his field to search out the faults of clay. He tests the clay honestly and sends back the results of the test, and is expected and expects, to give guarantees in regard to the working behavior. It is not his fault if the clay has had drying qualities, short burning range, scumming or efflorescence difficulties, bad color or lack of color range. Neither his machinery nor his test is at fault if the clay contains iron pyrites or concretionary iron or lime, if it develops cooling cracks or is seriously handicapped by porosity or lack of hardness range.

Cause of Failures

The manufacturer knows what his equipment will do with the material and there his responsibility should end. If failure follows, the fault largely lies with the owner of the material or the promoter of the project. The work of an occulist and optician are a parallel; the one tests your eyes, the other fits your glasses to them. If the eyes are normal, if they are not defective other than mere focal adjustment, the optician's work is satisfactory, otherwise not. In clayworking the time to settle such questions is before the plant is built, not afterward.

A recent test is illustrative. The material required an excessive amount of water to pug and it changed quickly from a mealy mass to one too soft to work. Unless tempered just right, there is danger of breaking the machine on one hand, or, on the other hand, ware too soft to handle. This fact, small as it seems, should be brought out and the factory equipped for a more uniform degree of pugging than is generally provided. Thousands of dollars may be lost in factory operations before this fault is determined and corrected.

In the laboratory tests it is often necessary to supplement the tests by chemical or mineralogical research. These are of little value alone, but are often of great value in determining the cause of failure.

Nearly every clayworker appreciates the troubles and loss in drying. One may build a dryer and if it fails, build another, and another, if his money holds out, until he has found a satisfactory one or proven that the clay cannot be profitably dried. Many have done this. We have seen clays possessing all the desirable machine qualities with none of the defects, yet they would persistently crack under all degrees of drying treatment that might be commercially practicable. The burning range was sufficient and the color good, but the clay was worthless because the market would not warrant the expensive treatment necessary to insure reasonably good ware.

Laboratories cannot be equipped with all types of dryers, but must be equipped to determine the drying qualities of a clay. Ohio probably has more good and fewer bad clays than any state in the Union. Of the sixty-eight known clays tested, only 15 per cent. were first class, namely: That could be safely dried in twenty-four hours or less; 51 per cent. were second class, requiring from thirty-six to seventy-two hours to dry safely; 19 per cent. required from seventy-two hours to one week to dry safely, and 15 per cent. required some preliminary treatment to make them practical. These dryers may be operated as sample dryers duplicating commercial dryers, or they may be adapted to special humidity conditions.

Shrinkage

Drying and burning shrinkages are obtained by marking the test bars with an instrument. The points are set accurately 100 mm. apart. When the ware is finished and set to dry, it is stamped very lightly, leaving a sharp yet distinct impression. At any stage of the test thereafter the distance between the point marks may be read directly in percentage on a millimeter scale. As a method adapted to all classes of clays we find it superior to anything yet proposed.

The burning requires a variety of kilns and must be under the direction of someone who has a knowledge of combustion and the effect of oxidation and reduction of pimpling, black coring, bloating and other burning difficulties. A description of these kilns is out of place here, but suffice it to say laboratory kilns are very inadequate for burning sample ware, but they have been designed and are operated to determine the difficulties in burning clay wares.

Following the burning comes the examination and testing of the ware, hardness and porosity, sometimes a freezing and thawing test is required to determine the value of the product. Color and color range must be considered and this involves getting a series of results at different temperatures. A clay may burn light red, dark red to brown within three cones. Another may be dark red through a range of five or six cones. If we select the dark red of the first to compare with a dark red of the second, it may have the better color, but because of the limited range of good color it is doubtful material for a profitable business.

Ordinarily we carry the burning through a range of fourteen cones, 07 to 7, which includes the average commercial kiln temperatures, not counting pottery or refractories. The greater number of red burning clays fail at or below cone 7. On the other hand, an occasional clay develops a good body below cone 07, as shown in curves No. 2 and No. 7.

Scumming

Scumming must be looked for and reported and tests must be made for efflorescence. Blistering and popping must be accounted for. Vitrification range is very important for an impervious ware and besides in paving materials the character of vitrification must be considered.

Attempts have been made to develop a satisfactory laboratory test for payers without success. Only a commercial test, followed by a rattler test, is conclusive. The ordinary preliminary tests, however, show the character and range of vitrification and serve to eliminate any clays which are not worth further testing.

Third Longest Steel Arch

The Needles bridge, across the Colorado River between Arizona and California, near Needles, Cal., which was dedicated on March 25, is the third longest steel-arch bridge span in the United States. Its 592-ft. arch is surpassed only by the 840-ft. Clifton arch at Niagara Falls and the 979½-ft. Hell Gate arch at New York City. This new highway bridge is the second highway crossing of the Colorado in the 1,000 miles from its mouth in the Gulf of California.

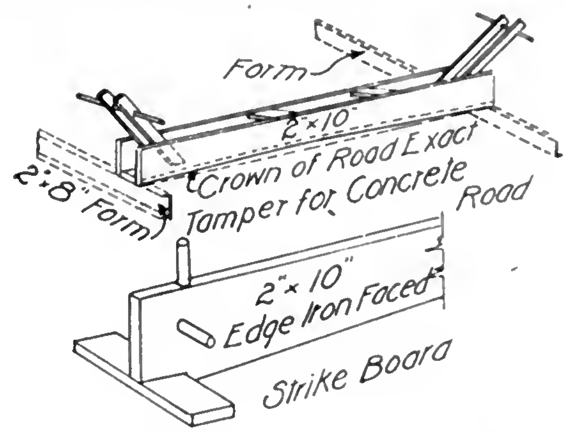
The Needles bridge is a three-hinged braced steel arch, 592 ft. centre to centre of end pins and with 100-ft. rise. The floor, a 22-ft. highway, is suspended from the arch ribs in the middle of the span and supported by posts at the ends. Approaches at each end, of 56 ft., make a total floor length of 832 ft. The end hinges are of the ordinary pin type, but the centre hinges are of the ball-and-socket type with a spherical compression bearing.

The method of erection was unique. The trusses from both the California and Arizona sides were built with the crown end resting on temporary pilework in the middle of the river and with the end hinges in place against the abutments. One truss was built so as to rest on the other. The tower for hoisting the trusses to make the centre-hinge connection was built from the material that was later used in the floor system. Sufficient end bracing was left from each truss to allow it to be hoisted into position without striking the tower, which was slightly narrower than the width of the trusses. The bridge was designed by J. A. Sourwine, County Surveyor, San Bernardino County, California. The steel was fabricated and erected by the Kansas City Bridge Company. J. P. Kemmerer was the construction engineer in charge of the work. The total cost of the bridge, exclusive of the concrete wing walls for the abutments, was $75,500. The Federal Government, the State of California and the State of Arizona each contributed $25,000, while the balance was furnished by the County of San Bernardino.—Eng. News.

A Combination Tamper and Strikeboard

For best results, concrete should be thoroughly tamped, and be as dense as possible. For sidewalk and road construction the practice generally followed is to place the concrete of such a consistency that it will not slide on a grade. While this is advantageous in so far as efficient handling is concerned, it is not conducive to best results in the matter of density. Especially is this true when the rapid commercial methods of striking off are used; the concrete is merely sheared off to the desired level, rather than tamped down. If a strikeboard which could be used as a tamper as well could be made, a firmer and more dense surface would result than one from the shearing action alone of the ordinary strikeboard. For this reason handles should be provided to the strikeboard, so that it can be worked up and down as it is drawn ahead. The following suggestion of such a combination is taken from a report of the Committee on Mixing and Placing Concrete as presented at the National Conference on Concrete Road Building, Chicago.

The construction of the tamper and strikeboard is very simple, as shown in Fig. 1, the strikeboard being crowned slightly in excess of the finished road requirement, while the tamper is finished to the exact cross-section of the finished road. After the concrete is struck off in the usual way for 10 or 15 ft., the center



being left slightly high, the tamper is used by two men, and moved forward a few inches at each application until the strikeboard is reached. In addition to giving the benefits of tamping for density, this brings the mortar to the face so that very little floating is necessary to secure a nicely finished road.

New Eight-room Public School for Cochrane, Ont.

(Continued from page 381)

The first floor plan is similar to the ground floor, except that a teachers' room takes the place of the principal's room, and the space over the entrance vestibule is reserved for a library. The staircases are at each end of the main corridor, and are built of oak.

The class-rooms are lighted with large mullioned windows from the left side only, with provision for electric lights. The walls have a 7-ft. dado of burlap, with a tinted sanded finish plaster above. The ceilings are stamped metal, and all the floors except the basement, which is concrete, are double, with insulating quilt and strips, the top or finish floors being hardwood. The ventilation is by heating ducts, which take off the foul air, fresh air being supplied through cased, indirect steam-heated radiators. Plumbing requirements are modern, and very complete.

The school was designed and its construction will be supervised by Angus & Angus, architects, North Bay and Sudbury, Ont.

Messrs. T. H. Higginson Limited, 70 Lombard St., Toronto, have just finished the sprinkler system in the South plant of the Goldie & McCulloch Co. Ltd., of Galt, Ont., within the time limit, and they have been awarded the contract to equip the North plant.

Montreal Builders' Exchange

Although the Montreal Builders' Exchange requested the Board of Control to revise the schedule of wages to be inserted in civic contracts, the scale as adopted shows little change. In two or three instances a slightly lower rate has been inserted, but in the main the schedule is from 5 to 15c an hour above that paid by the best city contractors. The following are the rates: Bricklayers, 55 cents per hour; carpenters and joiners, 45; cement finishers (foreman) 40; engineer on the crane, 35; electricians, 40; electricians' helpers, 27½; do. laborers, 22½; elevators: constructors, 35; iron workers: structural, 35; do. ornamental, 30; laborers, common, 25; do. on buildings, 25; lathers: metal, 40; do. wood, 35; masons, 50; marble cutters, 45; do. setters, 45; plasterers, 45; painters, 40; plumbers, 42½; do. helpers, 27½; do. steam fitters, 42½; do. steam fitter helpers, 25; stone cutters, 50; sheet and metal workers, 40; tile layers 45-50; carters: single wagon, $3.75 per day; do. double wagon, $6 per day.

For road work the rates are: for laying curbstones and flagstones, 35 to 45 cents per hour; for laying paving blocks, 48 cents an hour, and for asphalt, 40 cents an hour. Cement sidewalk finishers are to be paid 42 cents an hour. The wages of helpers are to be from 20 to 35 cents an hour.

Members of the Montreal Builders' Exchange on April 11 paid a visit to the Forests' Products Laboratories, University Street, Montreal. They inspected various departments, including those for the testing for strength of lumber and for the creosoting of lumber. The Laboratories have installed a small experimental plant for the latter purpose. Experiments are also constantly being carried on with a view of determining different uses to which Canadian woods can be applied, and of substituting native woods for purposes for which imported woods are now employed.

The Montreal Builders' Exchange have made a request to be represented on the Board of the Montreal Technical School. A deputation which waited on Sir Lomer Gouin, the Provincial Premier, received a very sympathetic hearing, the Premier promising to take the matter up with his colleagues. It was suggested by the deputation that representation of the Exchange on the school board would encourage young men to become more technically efficient in the building trades.

Increased Demand for Canadian Asbestos

Before the outbreak of the European war over 50 per cent. of Canada's asbestos was shipped to Germany and Austria, writes Consul Felix S. S. Johnson, from Kingston. When war broke out the two big asbestos corporations doing business in Canada found matters almost at a standstill. In a surprisingly short time they found a new and larger market for their entire output, with the result that the sales of the Asbestos Corporation of Canada increased 12½ per cent. over those of 1914, while the Black Lake Asbestos Co. turned a deficit of $32,000 in 1914 into a profit of $20,000. Prior to the war asbestos was used largely for industrial purposes, such as the making of shingles, fireproof boards, fireproof curtains for theatres, covering for machinery, etc. Today Canadian asbestos is finding a market in Great Britain, where it is being used as packing, for the covering of boilers and piping in the new ships built, and for other purposes.

Business Prospects Bright

Bird & Son, whose Roofing and Wall Board factory is located at Hamilton, report business prospects for 1916 as exceptionally good. Building operations and repairs, especially on the Western farms, have been more or less held up during the last two years, and now with money flowing more freely again, and prosperity returning, extensive repairs and new buildings are being pushed rapidly. Bird & Son are well posted as to actual conditions throughout the country, having branches in Vancouver, Calgary, Winnipeg, Montreal, Halifax, St. John, and Edmonton, from which their well known Neponset Paroid Roofing, Neponset Wall Board, and other products are distributed.

Preparing Harbor Plans

Mr. A. D. Swan, consulting engineer, of Montreal, is preparing plans for the mechanical equipment of harbors in Newfoundland, on the instructions of the Anglo-Newfoundland Development Company. The high freights now being charged by steamship owners have made it necessary to install machinery for the rapid handling of steamers. Canadian harbors are not, as a rule, provided with complete mechanical equipment, thereby making the charges of handling very high as compared with those prevailing in the United Kingdom.

Canadian Fairbanks Morse

Against a net loss of $101,099 in 1914, the accounts of the Canadian Fairbanks Morse Company for 1915 show a net profit of $709,048. The company's recovery was due to the demand for machines and equipment for munition factories and the enormous harvest in the West. Mr. H. J. Fuller, the president, states that the company's facilities are being at present taxed to the utmost, and prospects are good for the balance of the year.

Montreal Branch C.S.C.E.

The Rolling and Floating Steel Caissons of the Levis dry dock were described by Mr. L. R. Thomson at a meeting of the mechanical section of the Canadian Society of Civil Engineers, Montreal, on March 30. The dock, when finished, will accommodate the largest vessels afloat, and is being built for the Government by M. P. and J. T. Davis. The work on the caissons is sub-let to the Dominion Bridge Company, and is now in course of completion.

Correction

In the description of the Dale Presbyterian Church, Toronto, which appeared in last week's issue of the Contract Record, we inadvertently misspelled the name of the Eberhard-Wood Manufacturing Company, the contractors for the iron stairways.

A report from Quebec states that the Provincial Government has decided to construct an asphalt road between the city of Quebec and Valcartier camp. The greater part of the cost of $125,000 will be borne by the Provincial Government.

Cement Blocks vs. Bricks

Windsor, Ont., April 13th, 1916.

Editor Contract Record:

We were very much interested in a letter on the subject of "Cement Bricks" which appeared in the March 29th edition of your very excellent magazine and are taking the liberty of calling this gentleman's attention to certain facts relative to cement blocks, which he has apparently overlooked.

The cement block has certain advantages over brick and these points were described in the article written by W. W. Pearse, C.E., city architect for the city of Toronto. He states that, "cement blocks are here to stay as they appear to have certain advantages over solid brick. Being hollow, they are warmer and drier." He also says, "It is very generally accepted that a hollow cement brick wall is warmer in winter and cooler in summer than solid brick."

Yet this letter in your issue of March 29 tells us that, "they are neither as dry nor as warm as a brick wall—you cannot keep iron, steel, or leather goods in a cement building without keeping them well packed." This gentleman can tell you in a very few words why such is the case. We venture to say if he were asked his reply would be: "Because they are made from the dry-mix."

There you have the key to the situation. Make your blocks from the wet-mix or slush concrete and you at once eliminate all the objections mentioned by Mr. Thompson and retain the advantages over brick, described by Mr. Pearse.

Mr. Thompson has been in the business twenty-six years and apparently does not know that poured cement blocks are now being manufactured from the wet-mix concrete and that they are superior to brick. Clay brick will disintegrate in time; cement blocks, like wine, become better with age.

In Mr. Thompson's city, a certain machine company built an addition to their plant and used a poured cement block. All their valuable stock and tools are stored in this addition and the proprietors state that the place is perfectly dry and that there is absolutely no sign of moisture on the walls. These walls are neither lathed or plastered.

We will admit that Mr. Thompson is justified in his severe criticism of the cement block, when he refers to the dry-tamp product. However the wet-mix concrete is being substituted for the dry in practically all lines of cement work and in no product is this change more necessary or beneficial than in that of the cement block.

We trust Mr. Thompson will agree with our statement that a wet-mix cement block is cheaper, costs less to lay and is a better building material than solid brick.

Yours very truly,
Cast Stone Block & Machine Co., Ltd.
By F. J. Kinzinger, Secty.

Tenderer Deserves More Consideration

The Sherbrooke Board of Trade has passed a resolution asking the Federal Government to instruct the different departments to alter the present system of tendering so far as it relates to the retention of certified cheques—given as evidence of good faith—for certain percentages of contracts tendered on. The resolution points out that the cheques of the successful bidders are not only retained but are cashed and the proceeds held in the Government bank account until the respective contracts are completed to the satisfaction of the Government.

This procedure, it is contended, ties up unduly and unnecessarily for indefinite periods, capital and credit of the various contractors, needed in many cases to properly finance them through the very contracts they apply to—a particularly undesirable procedure in such a young country which needs every cent of capital and credit for expansion and development. While such procedure may not have a serious or detrimental effect in the case of large contractors who have immense capital, yet it undoubtedly and frequently deters and often debars contractors of merit, who have not sufficiently abundant capital or credit to allow a large amount of same to lie dormant, from tendering on public contracts, all to the detriment of the best interest of the public.

It is suggested that the Government should accept from successful tenderers guarantee bonds of approved Trust and Guarantee Companies, in lieu of accepted cheques, after the awarding of a contract, this method having been found satisfactory in many other cases.

The Montreal Builders' Exchange has endorsed the resolution and will ask other builders' exchanges to follow this example.

Manitoba Branch C.S.C.E.

At the last regular meeting of the Manitoba Branch of the Canadian Society of Civil Engineers, held at Winnipeg, Mr. Victor Gilbault delivered an interesting address upon the Panama-Pacific Exposition, which was illustrated with lantern slides supplied by Mr. M. C. Hendry. Mr. W. G. Chase, of Winnipeg, explained those slides pertaining to the waterpower developments throughout Canada.

The Department of Mines have issued bulletin No. 13, being a description of the laboratories of the Mines Branch of the Department of Mines, Ottawa.

Members of the Vancouver Branch C.S.C.E. on Active Service

Members—W. M. Davis, Colonel, 47th Battalion; J. R. Grant, Lieutenant, Royal Engineers; H. St. J. Montizambert, Lieutenant, 29th Battalion; J. H. Parks, J. M. Rolston, 29th Battalion.

Associate Members—H. L. Bodwell, Adjutant, 47th Battalion; J. F. Cahan, Lieutenant, 1st Canadian Pioneer Battalion; J. R. Cosgrove, Lieutenant, Div. Engr. 1st Canadian Contingent; J. A. Delancey, C. G. Du Cane, Major, Royal Engineers; M. L. Gordon, LeR. F. Grant, Adjutant, Can. Overseas Rly. Constn. Corps, c/o Office 1/c Records, London; N. M. Hall, 2nd Lieutenant, Royal Engineers; E. N. Harvie, 6th D.C.O.R., Vancouver; J. B. Holdcroft, Sergeant, 6th Field Co. Div. Engineers; R. G. E. Leckie, Colonel, 16th Battn., 1st Contingent; Campbell Macdonald, Lieutenant, Eng. Corps, 1st Contingent; Thos. Murhead, Lieutenant, 30th Battalion, 2nd Contingent, K. M. Perry, 1st Contingent.

Juniors—A. W. McKnight, Lieutenant, Div. Engrs. 1st Contingent; W. S. Ford, Private, Can. O'seas R'ly Constn. Corps.

Students—J. Hammer-Schou, 2nd Contingent; A. E. Humphrey, Captain, 2nd Contingent; J. C. Glanville, 1st Contingent.

Roll of Honor—D. P. Bell-Irving, Lieutenant, Divl. Engrs. 1st Can. Contingent.

Personal

Mr. Angus Matheson, a brick mason of Fort Frances, Ont., has enlisted for overseas service with the 141st Battalion.

Mr. Hugh Walker, a well-known contractor of Algonquin, Ont., has just returned from a four months' visit to England and France.

Mr. J. Martin Sterling was the guest of honor at a banquet given by local engineers in the Vancouver Hotel, Vancouver, B. C., on the 8th inst.

Mr. R. S. Lea, Montreal, has been in attendance at the session of the International Waterways Commission, Washington. Mr. Lee reported to the Commission on the level of the Lake of the Woods, Manitoba.

Mr. E. D. W. Courtice, Assistant Superintendent of the John Street Pumping Station, City of Toronto, has resigned his position to enter the employ of the Hare Engineering Company Limited, as Assistant Engineer.

Mr. N. K. Hay, who has been city engineer of Sydney, N. S., for the last three years, has resigned his position to enlist in the 224th (Forestry) Battalion. He has been granted leave of absence while at the front.

Mr. John D. McBeath, a well-known civil engineer of Moncton, N.B., has been given a commission with the Canadian Engineers for overseas service, and will leave shortly for Ottawa, where he will take the necessary course. Mr. McBeath is a graduate of the University of New Brunswick, and was for a time assistant engineer in Moncton, and later assistant engineer in Medicine Hat.

Lieut.-Col. J. A. Hesketh, recently connected with the engineering staff of the C. P. R., has been promoted from Major to Officer Commanding the Lord Strathcona Horse, with the rank of Lieutenant-Colonel. Lieut.-Col. Hesketh is well known in Winnipeg, where he resided for a number of years, and also throughout the West. He is a graduate of the Royal Military College, Kingston, and served in the North-West Rebellion. He was director of bridge work for the C. P. R. throughout the West, and is a member of the Canadian Society of Civil Engineers.

Obituary

Mr. Frank Anthony, a retired painting and decorating contractor of Brampton, Ont., was accidentally killed on April 8 by falling from the railway bridge near Brampton station to the street below.

The death occurred, on April 9, of Mr. David A. McIlroy, a prominent manufacturer of Hamilton, Ont. Mr. McIlroy, who was born in Hamilton thirty-seven years ago, commenced his business career as a junior in the office of Hendrie & Co., of Hamilton. Later he transferred to the office of the Hamilton Bridge Works Company, in which he rose rapidly to a position of trust, which he held for many years, until failing health compelled his resignation five years ago. After spending a year travelling in the south, he returned, with health improved, to Hamilton, and started the Hamilton Steel Construction Company. The news of his death came as a shock to his friends, as his condition was not considered serious until a few days before he died.

The Hare Engineering Company Limited, have recently received a contract to install their Fulton Water-cooled Mechanical Stokers in the new plant being built by the York Knitting Mills Ltd., Toronto.

If, as anticipated, the C. N. R. goes to Medicine Hat, Alta., this year, it is announced that the Saskatchewan Bridge and Iron Works will complete and operate their plant there, employing some 200 men.

Mainly Constructional

East and West—From Coast to Coast

The Iron Works, Limited, Owen Sound, Ont., have obtained a charter.

The Cement Company of Port Colborne, Ont., have resumed operations.

The city of Ottawa has seventy-two applications for the office of Works Commissioner.

The International Engineering Company, of Montreal, report a profit of $77,778 for the year 1915.

The building permits issued by the city of Hamilton this year to date represent an expenditure of $159,315.

The style of the Berlin Machine Works, Limited, Hamilton, Ont., has been changed to P. B. Yates Machine Co., Ltd.

The name of the Chateauvert Quarry Company, Limited, has been changed to that of Deschambault Quarry Corporation.

The City Council of Toronto has made an additional grant of $100,000 towards the cost of the Toronto-Hamilton Highway.

It is rumored that the Canada Cement Company have an order for one million barrels of cement from the French Government.

The Canadian Steel Specialty Company, Limited, has been organized, with head office at Grimsby, Ont., and a capital of $100,000.

The Builders' Exchange of Saskatoon, Sask., at a recent meeting, passed a resolution favoring the erection of an incinerator in that city.

Messrs. Wm. Steele & Sons Co., Philadelphia, Pa., Architects & Engineers, have opened an office at Room No. 423 Ryrie Bldg., Toronto.

There are signs of a marked improvement in the building trades in Toronto. On the 6th inst. the city issued building permits representing an outlay of $21,700.

Messrs. R. S. and W. S. Lea, of Montreal, will report on improvements to the water power at the paper mills at Pont Rouge, P. Q., of F. W. Bird and Son, East Walpole, Mass.

Fowler Machine Works, Limited, is the name of a recently incorporated company with head office in Vancouver and capital of $10,000, to carry on the business of iron-founders, mechanical and electrical engineers, brassfounders, boiler-makers, etc.

The building permits issued by the city of Ottawa during January, February, and March, 1916, totalled $156,900—an increase over the same period of last year of $28,475. Ottawa contractors complain of the indisposition of the loan companies to advance money for large buildings at the present time.

A commission of water experts, consisting of Messrs. R. S. and W. S. Lea, Montreal; F. W. Thorold and Co., Toronto; and Mr. F. A. Dallyn, sanitary engineer of the Ontario Provincial Board of Health, will report on the water supply for the city of Sarnia, Ont. The object is to obtain a better and larger supply of water.

The Builders' Exchange of the City of Stratford and County of Perth, Ont., held their annual meeting on April 6, marking the close of a very successful year, during which the membership had almost doubled. Mr. George Pounder was elected president. After the business of the evening had been disposed of the members held their annual banquet at the Royal Cafe.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Beauceville, Que.
The Town Council propose to construct a quantity of concrete sidewalk this season. Clerk, F. Fortin.

Clarendon, Que.
The Municipality intend to spend $5,500 on roads during this season. Secretary, E. T. Hodgins, Shawville.

Clinton, Ont.
The Town Council are considering extensions to the waterworks system, to cost about $5,000. Engineer, J. H. Chant.

Edmonton, Alta.
Plans for extensions to the water and sewage systems have been submitted to the City Council by Engineer A. Haddow, Civic Block. Approximate cost, $15,000.

Ely Township, Que.
The sum of $4,550 will be expended on macadam roads this season by the Municipal Council. Secretary, G. A. Racine, Valcourt P. O.

Lanoraie, Que.
The Municipal Council intend to spend $9,000 on road work during this season. Secretary, L. J. Desrosiers.

Leamington, Ont.
The Town Council propose to lay a number of gas and water mains and sewers. Clerk, R. M. Selkirk.

North Bay, Ont.
Tenders on the construction of sewers will be received until 5 p.m., April 28th, by Town Engineer H. J. McAuslan.

Notre Dame de Portneuf, Que.
The sum of $3,500 will be expended on roads this season by the Municipal Council. Secretary, N. Marcotte, Portneuf Station.

Ottawa, Ont.
The City Engineer, F. C. Askwith, proposes to advertise for about 1,500 lineal feet of steel forms for concrete sidewalks.

Outremont, Que.
The estimates now being considered by the City Council include the following:—concrete sidewalks, $15,000; sewers, $17,000; grading and macadamizing, $36,500; granite block paving, $5,250; garbage destructor, $17,700. Clerk, E. J. Samson.

Port Colborne, Ont.
The Canada Cement Company have decided to postpone the construction of concrete roadways at their plant.

Saskatoon, Sask.
Tenders may be called shortly for the completion of the sedimentation basin which was commenced in 1914. Cement, sand and gravel will be required. City Engineer, G. D. Archibald.

St. Catharines, Ont.
The City Council will shortly call for tenders on the construction of a relief sewer on Carlton Street. Prices will be asked on concrete segment block and brick construction. Engineer, V. P. Near.

St. Severe, Que.
P. Gelinas proposes to spend $8,000 on the construction of waterworks this season.

Toronto, Ont.
The Board of Control will receive tenders until April 25th for excavation, laying and jointing of waterpipes, etc., required during the year. Plans at Room 320, City Hall.

The Board of Control will shortly start work on improvements on the Humber Boulevard, including a concrete roadway and grading. Estimated cost, $31,000.

The Board of Control will receive tenders until April 25th on quantities of asphalt, bitulithic and brick block paving, concrete walks and curbs. Plans and specifications at office of Works Department.

Villeneuve Township, Que.
Road work estimated to cost $3,500 will be done this season by the Municipal Council. Secretary, C. L. Morin, Val des Bois, Que.

CONTRACTS AWARDED

Bienville, Que.
The Municipality have let the contract for supply of cast iron pipe to Drummond, McCall, 28 Victoria Square, Montreal, and for clay pipe to Pruneau & Company, 140 St. Peter Street.

London, Ont.
The contract for laying asphalt pavement on Beaconsfield Avenue for the City Council has been let to the Standard Paving Company, Central Chambers, Ottawa. Approximate cost, $7,000.

Toronto, Ont.
The Board of Control have awarded contracts to the following firms for asphalt paving:—Godson Contracting Company, Manning Chambers, $16,900; Constructing & Paving Company, Confederation Life Building, $30,850; Grant Contracting Company, Front Street East, $4,100; Works Commissioner Harris, bitulithic, $18,800.

Winnipeg, Man.
The Provincial Department of Public Works have awarded the contract for the construction of watermains and other services for the Deaf and Dumb Institute to Nagle & Dunlea.

Railroads, Bridges and Wharves

Essex, Ont.
The Town Council propose to have plans drawn for a cement bridge on Victoria Street, and will appoint an Engineer. Clerk, R. R. Brett.

Kettle Rapids, B.C.
Tenders on the construction of a large steel bridge will be called privately by the Department of Railways & Canals, Ottawa. Minister, Hon. F. Cochrane, Ottawa.

Prince George, B.C.
The Provincial Department of Public Works, Victoria, have prepared plans for a bridge to be constructed over the Nechako River, and have submitted them to Ottawa for approval.

Welland, Ont.
C. J. Laughlin, Jr., is building an electric railway from Welland Town to Welland Junction.

Public Buildings, Churches and Schools

Basswood, Man.
Tenders on the erection of a school will be received until 5 p.m., April 25th, by the Secretary to the School Board, James Robertson. Architect, Frank R. Evans, 901 Confederation Life Building, Winnipeg. Estimated cost, $14,000.

Birchcliff, Ont.
Plans of a church to be built for St. Nicholas Anglican Congregation have been prepared by Carter & Ford, and tenders will be called shortly. Estimated cost, $13,000. Brick construction.

Cameron, Man.
The by-law to authorize the erection of a school has been carried and F. D. Tuttle, 705 McArthur Building, Winnipeg, appointed as Architect. Approximate cost, $4,000.

Charlottetown, P.E.I.
The City Council intend to have plans prepared for an addition to the City Building. Clerk, W. W. Clerk.

Dunach, B.C.
Tenders on the erection of a school will be received until noon, April 25th, by J. E. Griffith, Deputy Minister of Public Works, Victoria. Plans and specifications with F. C. Campbell, Government Agent, New Westminster; J. Mahoney, Agent, Vancouver, William Meryfield, Secretary to the School Board, Mt. Lehman, and at the Department

Finch, Ont.
Tenders on the erection of a six-roomed school for the Trustees of School Section No. 3 will be received until noon, April 26th. Plans and specifications with the Secretary, G. S. Casselman, Finch. Approximate cost, $14,000.

Fraserville, Que.
The Town Council are considering the

reconstruction of the Town Hall. Clerk, E. Talbot.

Fredericton, N.B.
The Trustees of Victoria Hospital are considering the erection of a wing, provision for which was made by the late Donald Fraser. President, R. B. Van-Dine.

Howe's Lake, N.B.
F. Neil Brodie, 42 Princess Street, St. John, is preparing plans of an isolation hospital for St. John's County. Secretary, J. King Kelly, Prince William St., St. John.

Listowel, Ont.
The Town Council are considering the installation of heating and ventilating systems in two schools, and other alterations. Particulars from Trustee Smith.

Macklin, Sask.
The Trustees of School District No. 2420 have been authorized to borrow $3,200 for the completion of a school. Treasurer, A. W. A. Corscadden, Macklin. Brick construction.

Maisonneuve, Que.
Rev. E. Contant, 599 Adam Street, is having plans prepared for a Presbytery, estimated to cost $45,000. Tenders will be called in June. Stone and brick construction.

Mersea and Gosfield Townships, Ont.
A site will be selected and plans prepared as soon as possible for a school to cost about $6,000. Particulars from W. H. Nohle, Cottan.

Ninette, Man.
The Provincial Department of Public Works are considering the erection of an addition to the Sanatorium, at an approximate cost of $30,000. Architect, J. D. Atchison.

Ottawa, Ont.
Tenders on the installation of metallic fittings at the Customs House, Sussex Street, will be received until 4 p.m., April 27th, by R. C. Desrochers, Department of Public Works, Ottawa. Plans and specifications with E. Francis, Post Office, London; R. L. Deschamps, Overseer, Post Office, Montreal; A. Hastings, Postal Station F. Toronto, and at the Department. Specifications at office of MacLean Daily Reports, Limited, 25 Charlotte Street, Toronto.

Outremont, Que.
Tenders on the supply of desks, seats and chairs for the Bloomfield Street School will be received until noon, May 1st, by J. A. Gauthier, 464 Durocher St.

Quebec, Que.
Tanguay & Lebon, 20 d'Aguillon St., have prepared plans of a college for the Commercial Academy, Cook Street, and will call for tenders privately. Estimated cost, $200,000.

St. Thomas, Ont.
Plans are being prepared for a Mission Building to be erected on Fifth Avenue for the Central Baptist Church, at an approximate cost of $6,000. Architect, J. T. Findlay, 386 Talbot Street.

Timmins, Ont.
Tenders will be received until May 15th for the erection of a school for the School Board. Architect, Canadian Mining & Finance Company. Estimated cost, $12,000. Frame construction.

Toronto, Ont.
The Board of Education will receive tenders until April 27th for the following work at the Administration Building, College Street:—concrete walks and driveway, cabinet work, counters, partitions, doors, ornamental iron work, spiral stairs, railings, leaded lights, elevator, ash hoist, vault doors and hardware.

Tenders will be received until April 25th for the supply and installation of steel furnishings for the Registry Office. Plans and specifications at office of the City Architect.

Glenmount Methodist Church have had plans prepared for a new brick and frame building, to cost about $6,000. Tenders will be called shortly. Chairman of Committee, E. Faw, 27 Fairmount Cres.

Welland, Ont. ... ...
Plans are to be prepared for an addition to the Welland County Hospital. The Architects will probably be Langley & Howland, King Street West, Toronto, who designed the existing building. Approximate cost, $30,000.

CONTRACTS AARDED

Caradoc, Ont.
In connection with the erection of a school for the Trustees of School Section No. 1, the masonry contract has been awarded to Northey & Tullett, 825 Dufferin Avenue, London, and the carpentry to J. B. MacVicar, Mt. Bridges.

Charlottetown, P.E.I.
In connection with alterations to the First Methodist Church, the contract for heating has been awarded to B. Stewart & Company.

Kingston, Ont.
The contract for repairs to the Convalescent Home on Fetter Cairn Island has been let by the Department of Public Works, Ottawa, to Robert Wallace, 380 Barrie Street. Approximate cost, $6,000.

London, Ont.
The contract for installation of seating at the new school has been awarded to George M. Henry Company, 215 Victoria Street, Toronto.

The Provincial Department of Health are having plans prepared for repairing the workshop at the Insane Hospital. Estimated cost, $8,000.

Louiseville, Que.
It is probable that the general contract for the erection of the proposed Parish Church will be let to J. Couture, 17 St. Joseph Street, Levis, and the carpentry to Paquet & Godbout, 21 William Street.

Orford Township, Ont.
In connection with the school now in course of erection for the Trustees of School Section No. 7, the carpentry has been let to D. L. Shafer, 131 Curtis Street, St. Thomas, and the wiring to Sandham & Roberts, 531 Talbot Street, St. Thomas.

Sandy Bay, Que.
The Roman Catholic Congregation have awarded the general contract for the erection of a church to A. H. Morin. Stone and concrete construction.

Wolfe Island, Ont.
The contracts for masonry, carpentry, plastering and painting required in the erection of the Roman Catholic Church have been awarded to the general contractor, the steel work to the Dominion Bridge Company, Imperial Life Building, Toronto, and the plumbing to F. R. J. Macpherson, 341 George Street, Peterboro.

Business Buildings and Industrial Plants

Benjamin River, N.B.
J. & A. Culligan propose to start work in the fall on alterations to the mill of the Prescot Lumber Company, Limited, which they have purchased.

Forest, Ont.
Howard Fraleigh will head a Company now being formed to equip flax mills at Alvinston and Petrolia. Approximate cost, $100,000.

Hamilton, Ont.
The Steel Company of Canada, Harvey Lane, have commenced the installation of two open hearth furnaces. Engineers, A. Laughlin Company, Pittsburgh, Pa.

La Tuque, Que.
Joseph Gauthier proposes to build a store and residence, at an approximate cost of $3,500.

Lions Head, Ont.
Saul Klengon is considering the erection of a store to replace that recently destroyed by fire. Approximate cost, $3,000.

London, Ont.
Plans are being prepared by J. M. Moore, 425 Richmond Street, for a warehouse to be built for Webster & Harvey, Richmond and Oxford Street. Estimated cost, $12,000. Fireproof construction.

Quebec, Que.
Simonds & Ritchie, 105 Mountain Hill, have prepared plans for a theatre to be built on St. John Street at an approximate cost of $6,000. Tenders will be called privately by the Architects. Brick and frame construction.

Rimouski, Que.
Plans have been prepared for a barn and stable to be erected for Rt. Rev. Andre Albert Blais. Frame and brick construction. Approximate cost, $5,000.

Saskatoon, Sask.
The Alaska Beeding Company, Gomex Street N., Winnipeg, have had plans prepared for a factory to be built on First Avenue N. Frame and mill construction.

Three Rivers, Que.
E. Morrissette and A. P. Gouin propose to start work immediately on the rebuilding of their business blocks, destroyed in the recent fire. Stone and brick construction.

Timmins, Ont.
Charles Pierce will receive tenders until April 25th for the erection of a theatre and business block. Frame construction. Approximate cost, $25,000.

Toronto, Ont.
The Flint Varnish & Color Company, Perth Avenue, are about to make alterations to a factory at Perth and Kingsley Avenues, estimated to cost $150,000. They will purchase the necessary material.

Work is about to start on the erection of a warehouse and factory on Terauley Street for the T. Eaton Company, Limited. Steel frame, reinforced concrete and brick construction. Estimated cost, $500,000. Engineer, George W. Thompson, Louisa Street

Tenders on all trades required in the erection of stores and apartments on Bathurst Street are being received by W. Argue, 235 Broadview Avenue. Estimated cost, $6,000. Brick construction.

H. S. Kaplan, 75 Macdonnell Avenue, will receive tenders until April 26th for the erection of an addition to the premises of L. Yolles, 379 Queen Street W. Estimated cost, $8,000. Plans have been redrawn. Brick and steel construction.

The Board of Control will shortly call for tenders on the erection of an addition to car barns, estimated to cost $25,000. Commissioner of Works, R. C. Harris.

A. M. Hough, 1666 Queen Street W., is receiving tenders on excavation required in the erection of a store and apartments on St. Clair Avenue, estimated to cost $6,000. Smaller trades will be let later.

A. Walker, 169 Lauder Avenue, has had plans prepared for a store and apartments to be built at an approximate cost of $6,000. Smaller trades will be let. Brick construction.

R. Barrett, 20 Roblock Street, has commenced the erection of three stores and residences on Danforth Avenue, and will let the smaller trades. Estimated cost, $9,000. Brick construction.

Plans are being prepared for a bakery to be built at Davenport and Dartnell Streets for the Harry Webb Company, Limited, 23 Buchanan Street.

Welland, Ont.
Frank Adelman has commenced the erection of six stores, estimated to cost $10,000. Frame construction.

Westmount, Que.
D. J. Crighton, 282 St. Catherine St. W., is preparing plans of a picture theatre to be built on Sherbrooke Street

Weston, Ont.
Barker & Farr have commenced the erection of a garage on Main Street, estimated to cost $6,000. Brick construction.

Winnipeg, Man.
The Royal Templars Hall Company have commenced the erection of a hall and office building on Young Street by day labor, under supervision of J. Simpson. Contracts will be let for plumbing and heating. Approximate cost, $10,000.

CONTRACTS AWARDED

Brantford, Ont.
In connection with the erection of a station for the Canadian Pacific Railway, the contract for heating and plumbing has been let to T. J. Minnes & Company, 9 King Street, and the electrical work to Harry Alexander, Bank of Toronto Building, Toronto.

London, Ont.
John Purdon, 429 King Street, has been awarded the general contract for an addition to a warehouse for John Fraser, Fraser House, King Street. White brick construction. Approximate cost, $3,000.

Merritton, Ont.
The contract for the erection of a reinforced concrete building and alterations to an existing building for the Riordan Pulp & Paper Company has been awarded to the John V. Gray Construction Company, Toronto.

Mitchell, Ont.
The general contract for an addition to the Mitchell Woollen Mills has been awarded to John Avery, Mitchell. Approximate cost, $5,000.

Montreal, Que.
The general contract for the erection of a block of stores and tenements for M. Field, 42 Dorchester Street West, has been awarded to Valin & Bail, 2 Lamoriciere Street. Brick and concrete construction.

Niagara Falls, Ont.
The Concrete, Stone & Coal Company, 504 Ferry Street, Niagara Falls South, have been awarded the general contract for the erection of a factory for the Dominion Safe & Vault Company, Farnham, Que., and have started work. Approximate cost, $7,000.

Ottawa, Ont.
The general contract for the erection of a rink on Argyle Street has been awarded to John Sutherland, 216 Cooper Street. Approximate cost, $25,000. Subtenders are now being received. Architects, Horwood, Taylor & Horwood, 130 Sparks Street.

The general contract for alterations to a building for G. P. Matthewman, 130 Sparks Street, has been let to Alexander Christie & Son, 253 Frank Street. Estimated cost, $7,000.

Paris, Ont.
The general contract for an addition to the premises of Penman's Limited has been awarded to P. H. Secord & Sons, 133 Nelson Street, Brantford. Mill and concrete construction. Approximate cost, $10,000.

Quebec, Que.
Work has been started on the erection of a factory for La Cie de Lithographie Limited, estimated to cost $7,500. The general contractor is T. J. Cote, Garneau Boulevard. Brick construction.

Sault Ste. Marie, Ont.
The City Council have let the contract for the erection of a power and pumping station to I. I. Fitzpatrick, Biggins Avenue, at $5,500. Stone, cement and steel construction.

Sherbrooke, Que.
Anglins, Limited, 65 Victoria Street, Montreal, have commenced the erection of a machine shop for the canadian Ingersoll Rand Company, Limited, estimated to cost $22,000. The contract for roofing has been let to Campbell & Gilday, 793 St. Paul Street West, Montreal.

Smooth Rock Falls, Ont.
The Mattagami Pulp & Paper Company, Limited, have awarded the contract for the construction of a dam, power house and railway to Morrow & Beatty, Limited, 415½ George Street, Peterboro, Ont.

Stamford Township, Ont.
The general contract for the construction of a carborundum plant for the Canadian Aloxite Company, Limited, Niagara Falls, Ont., has been let to the Brown-Pollard Company, Niagara Falls, N.Y. Brick and mill construction. Approximate cost, $100,000.

St. Thomas, Ont.
The following contracts have been let for alterations to an office building on Talbot Street for the Municipal World Limited:—masonry, J. S. Belbin, 142 Curtis Street; carpentry, P. A. Campbell, 67 Curtis Street; roofing, C. Riddle, 119 Wellington Street; plumbing, C. T. Bull, 7 Hiawatha Street; metal work, Ingram & Davey, Limited, 168 Talbot Street; electrical work, Sandham & Roberts, 531 Talbot Street.

Steelton, Ont.
The general contract for the erection of a storage building for the Algoma Steel Corporation, Wilde Avenue, Sault Ste. Marie, has been let to R. A. Gibson, 319 Albert Street, Sault Ste. Marie, and the masonry to Jannison & Sons, 635 Albert Street, Sault Ste. Marie. Approximate cost, $11,000.

Stratford, Ont.
The general contract for the erection of an addition to the premises of the Williams Trow Knitting Company, St. Patrick and Erie Streets, has been awarded to J. R. Myers & Son, 99 Ontario Street. Previous report in error.

Toronto, Ont.
In connection with the buildings now in course of erection for Gutta Percha & Rubber Limited, 47 Yonge Street, the contract for steel sash has been let to H. Hope & Sons, Limited, 45 King St. W., and the carpentry to George Sparling, 759 Dufferin Street.

The contract for masonry required in connection with the building now being erected for William Neilson Ltd., 277 Gladstone Avenue, has been awarded to Gordon Brothers, 1 De Lisle Avenue, and the steel work to McGregor & McIntyre, 1139 Shaw Street. Approximate cost, $10,000.

The Robert Simpson Company propose to erect a home for their employees, at an approximate cost of $250,000, and have let the general contract to the Wells Brothers Company of Canada, Limited, 95 Gould Street. Work will start shortly.

R. Robertson & Sons, Confederation Life Building, have started work on an addition to a garage for W. W. Dun, 367 Yonge Street. Estimated cost, $4,500. Brick construction.

The following contracts have been awarded for the erection of a grain warehouse and elevator for the E. W. Gillett Company, Fraser Avenue:—general contract, Witchall & Sons, 156 St. Helens Avenue; steel, McGregor & McIntyre, 1139 Shaw Street; carpentry, W. S. Henry, 11 Albertus Avenue; sheet metal and roofing, A. B. Ormsby Company, King Street W. Approximate cost, $30,000

The contract for ornamental iron, etc., in connection with the erection of a warehouse on Mutual Street for the Robert Simpson Company, Limited, has been awarded to the Canadian Ornamental Iron Company, 88 River Street. Previous report in error.

The Board of Control have let the general contract for the erection of frame and concrete barn at the Jail Farm to I. A. Wickett Limited, Traders Bank Building, at $25,723.

The contract for the erection of a stable building at the Island for the Board of Control has been awarded to Page & Company, 89 Crescent Road, at $3,813. Frame and concrete construction.

Welland, Ont.
The general contract for the erection of a factory for the Volta Manufacturing Company has been awarded to I. C. Diffin, Welland. Estimated cost, $3,500.

Westboro, Ont.
The contract for electrical work required in connection with the store now being built by I. A. Clark, Richmond Road, has been let to H. L. Allan, 377 Somerset Street.

Westmount, Que.
The general contract for the erection of a garage for O. H. & N. A. Timmins, 4 Park Crescent, has been let to E. Garrigan, 318 Gallantyne Avenue N. Brick construction. Approximate cost, $10,500

Windsor, Ont.
The Canadian Salt Company, Limited, Sandwich Street, have let the contract for the construction of a salt plant to the Westinghouse Church Kerr Company, New York City.

Windsor, Ont.
The general contract for alterations to a store on Ouellette Street for the Heintzman Piano Company has been let to J. R. Sculland, care of the Architects, Walker & McPhail, Tuson Building. Approximate cost, $3,000.

Residences

Carlow, Ont.
William Watson proposes to build a residence, at an approximate cost of $3,000, and is having plans prepared.

Charlottetown, P.E.I.
Work is about to start on alterations and additions to the residence of Russel White, North River Road. Frame construction. Approximate cost, $3,500. Architects, C. B. Chappell & Hunter, Des Brisay Block.

Clinton, Ont.
Plans are to be prepared for a residence to be built for William Glenn, Joseph Street, at an approximate cost of $3,500.

Cornwall, Ont.
Harry Williams is considering the erection of an addition to a residence on Pitt Street. Approximate cost, $3,000. Brick construction.

Dutton, Ont.
G. J. Binks, R.R. No. 1, has prepared plans for a residence, estimated to cost $4,000, and will start work shortly. Carbex brick construction.

Essex, Ont.
Plans of a bungalow will be prepared by William Wilcox, c/o Mrs. F. S. Adams, Essex. Estimated cost, $3,000.

Hamilton, Ont.
J. M. Honeyford, 180 Maple Avenue, is having plans prepared for three residences to be built on Kensington Street, at an approximate cost of $3,500 each, and for another on Prospect Avenue, estimated to cost $4,500. Brick construction. Greater part of work by owner.

Kingsville, Ont.
E. Scratch, Cedar Beach, Kingsville, has commenced the erection of a residence. Approximate cost, $3,000.

Komoka, Ont.
Richard Frank proposes to build a residence, estimated to cost $3,000. White brick construction.

London, Ont.
Plans of four residences to be built on Windsor venue for W. I. Spettigue, 261 Hill Street, are being prepared by J. V. Munro, Bank of Toronto Chambers. Estimated cost, $10,000. Red brick construction.

John Hayman & Sons, 42 Wellington Street, contemplate the erection of apartments, at an approximate cost of $40,000.

Plans are being prepared by W. G. Murray, Dominion Savings Building, for remodelling a residence for H. Colerick, 682 Queens Avenue. Approximate cost, $3,500.

Montreal, Que.
J. Sawyer, 407 Guy Street, is preparing plans for alterations to the residence of the Ste. Elizabeth Society, 29 Seymour Avenue. Approximate cost, $5,000.

J. Chrisaphi, 592 St. Christophe Street has commenced the erection of a block of flats, estimated to cost $10,000.

Preston, Ont.
James illies is considering the erection of two residences on Moore Street, and will prepare plans. Approximate cost, $6,000.

Quebec, Que.
Plans of a residence to be built on Lockwell Street are being drawn by E. C. Brochu, 147 St. Cyrille Street. Estimated cost, $8,000. Quotations are being received on British Columbia fir.

The erection of a residence is being considered by H. M. Cote, 631 St. John Street. Brick construction. Estimated cost, $18,000.

G. Cantin, 22 Lee Street, is preparing plans of a residence to be built on Cartrier Street, at an approximate cost of $7,000. Brick construction.

Plans have been drawn by J. Cauchon, 364 Richelieu Street, for a residence to be erected on Stigmates Street. Estimated cost, $8,000. Brick and concrete construction.

Freres Le Rossignol, 39 Decourcelles Street, have commenced the erection of a residence on Seventh Street, Limoilou. Estimated cost, $4,000.

A. Guilmette, 313½ St. Joseph Street, is building a residence estimated to cost $6,000. Frame and brick construction.

Work on the erection of a residence has been started by Alexander Fackney, 107 St. Joachim Street. Brick construction. Estimated cost, $7,000.

Norbert Cauchin, 59 Dorchester Street, is considering the erection of three residences on Cartier Avenue, at an approximate cost of $12,000. Brick construction. Work may start early in May.

Sault Ste. Marie, Ont.
Plans are being prepared for a residence to be built on Albert Street for R. T. Lane, 10 Queen Street. Approximate cost, $5,500.

T. R. Wilks, Queen Street, is preparing plans of a residence for W. H. Ewing, Albert Street. Estimated cost, $6,000.

Toronto, Ont.
T. A. Gibson, 423 Walmer Road, has had plans prepared for a residence to be built on Blythewood Avenue, at an approximate cost of $5,000. Contracts will be awarded shortly. Brick construction.

Hayward & Whitehorn, 6 Hallam Street, propose to start work shortly on the erection of a residence on Lauder Avenue, estimated to cost $5,000. Brick construction.

F. H. Miller, c/o Miller & Sons, Lauder Avenue, contemplates the erection of a residence, at an approximate cost of $5,000. Brick construction.

C. J. Cudmore, 62 Pacific Avenue, has commenced the erection of two residences on Glendenning Street, estimated to cost $6,000. Smaller trades will be let.

Venn & Evans, 776 Crawford Street, are receiving tenders on plastering, plumbing and heating required in the erection of a pair of residences at 14 Palmerston Square. Approximate cost, $4,500.

J. T. Twigg, 28 First Avenue, is about to start work on the erection of a residence, estimated to cost $3,500. Smaller trades will be let. Brick construction.

John Price, 100 Greenwood Avenue, is about to commence the erection of a pair of residences, to cost about $4,000, and will let the smaller trades. Brick construction.

H. H. Wood, 97 Avenue Road, is now receiving tenders on all trades required in the erection of a pair of residences on Ashworth Avenue. Approximate cost, $5,000. Brick construction.

Plans have been prepared for a residence to be built on Moore Street for J. Skelton, Room 36, No. 33 Richmond Street. Brick construction. Estimated cost, $4,800.

Plans of a rooming house to be built at 83 Gerrard St. E., are being prepared by A. W. & R. S. McConnell, 167 Yonge Street. Estimated cost, $12,000.

J. & T. H. Bishop, 68 Pembroke Street, propose to build three residences, at an approximate cost of $6,000 Tenders on smaller trades will be received after May 8th. Brick construction.

Tenders on all trades except carpentry required in the erection of a residence are being received by W. H. Avison, 573 Indian Road. Brick construction. Estimated cost, $3,500.

F. E. Larkin, 223 Fulton Avenue, has commenced the erection of three pairs of residences on Lamb Avenue, estimated to cost $7,300. Smaller trades will be let. Brick and roughcast construction.

Plans have been drawn for a pair of residences to be erected on Nairn Avenue for W. Pidgeon, 41 Nairn Avenue. Tenders on smaller trades will be received after April 25th. Brick construction. Estimated cost, $4,000.

W. H. Little, 528 St. Clarens Avenue, is building a residence, estimated to cost $3,000. Smaller trades will be let. Brick construction.

W. J. W. Butchart, 1 St. Ives Avenue,

has commenced the erection of a residence on Dawlish Avenue, and is about to start work on four others on St. Leonards Avenue. Estimated cost, $6,000 each. Smaller trades will be let.

Muir & Lumb, 63 Arundel Avenue, have had plans prepared for a pair of residences, to cost $4,000. Smaller trades will be let. Brick construction.

Tenders on excavation and brick work required in the erection of a residence are being received by William Davis, 3 Scarboro Road. Smaller trades will be let later. Estimated cost, $3,500.

Tenders on brick work required in the erection of four residences are being received by J. Stone, 49 Coleman Avenue. Smaller trades will be let later. Approximate cost, $5,000.

A. Edmonds, 105 Oakwood Avenue, has commenced the erection of a residence on Thome Crescent, and will let smaller trades. Brick construction. Estimated cost, $3,800.

Plans have been prepared for a duplex residence to be built by W. G. McClean, 499 St. Johns Road. Estimated cost, $5,000. Smaller trades will be let. Brick construction.

W. J. Nixon, 32 Columbine Avenue, has had plans drawn for a pair of residences, estimated to cost $5,000. Smaller trades will be let. Brick construction.

A. R. Wililamson, 304 Indian Road, has commenced the erection of an addition to apartments at Augusta Street and Grange Avenue, estimated to cost $12,000. Tenders for smaller trades will be called about May 10th. Brick construction.

Work on the erection of a residence has been started by F. Flubacker, 92 O'Hara Avenue. Estimated cost, $3,000. Smaller trades will be let. Brick construction.

Wellesley, Ont.
John R. Schmidt has commenced the erection of a residence. White brick construction. Estimated cost, $3,000.

West Lorne, Ont.
Dugald McCallum, Main Street, intends to prepare plans for a residence, to cost about $3,500.

Weston, Ont.
J. Nason, Main Street, has had plans drawn for a pair of residences, estimated to cost $4,000. Smaller trades will be let. Brick construction.

The Humber Home Development Company, Main Street, propose to build two residences, at an approximate cost of 4,000 each, and to resume the construction of another partly built.

CONTRACTS AWARDED

Barrie, Ont.
The contract for masonry required in the erection of two residences for W. C. Thompson, 15 Owen Street, has been let to John Sindry, the plastering and cement work to T. Thompson, and the heating and plumbing to Buchanan & Moffat, 86 Dunlop Street. Approximate cost, $3,000 each.

Charlottetown, P. E. I.
The general contract for the erection of a residence for A. E. Duff, Great George Street, has been awarded to H. & S. Lowe, 238 Hillsboro Street. Approximate cost, $9,000.

Eastview, Ont.
The general contract for the erection of a residence for F. Gladu has been awarded to J. Francouer. Brick construction. Approximate cost, $3,000.

Hamilton, Ont.
The contract for masonry required in connection with the residence being built by M. L. Fair, 121 Berlin Avenue, has been let to Lemington & White, 140 Roslyn Avenue, the carpentry and roofing to Blake & McDonald, 72 Central Avenue, and the electrical work to A. Phoenix, 241 McNab Street N. Estimated cost, $3,000.

The general, masonry, carpentry and roofing contracts for the erection of twelve residences for Williamson & Torrence, 948 Main Street E., have been let to S. S. Forbes, 165 Sanford Street S., the plastering to H. Hancox, 41 Robins Avenue, and the painting to J. Omand, 177 Walnut Street W. Estimated cost, $20,000.

Kingston, Ont.
The contract for electrical work required in the erection of an apartment house for James Elder, 207 William Street, has been let to the Halliday Electric Company, 345 King Street. Previous report in error.

Levis, Que.
The general contract for the erection of a residence on Fraser Street for L. Saindon, 34 Wolfe Street, has been awarded to J. Cote, 295 Richelieu Street, Quebec. Approximate cost, $5,000.

Lindsay, Ont.
The general, carpentry and roofing contracts for the erection of four residences for J. O'Reilly and L. V. O'Connor have been let to Neil Gray, the masonry to John Sproule, plastering to Way & Reeves & Company, and heating to W. R. Keys, Kent Street. Brick construction.

London, Ont.
The general contract for remodelling a residence and erection of a garage for John Smallman, Elmwood Avenue, has been let to John Putherbough, 1006 Wellington Street. Approximate cost, $10,000.

The general contract for the erection of a residence for R. Pearson, 459 Grey Street, has been let to T. Leah, 1047 Dundas Street. White brick construction. Estimated cost, $3,000.

William Copp, 22 Belgrave Avenue, has been awarded the general contract for the erection of five residences for the Copp Syndicate. Estimated cost, $15,000.

Ottawa, Ont.
The general contract for the erection of a residence for Frand Cowan, 1110 Somerset Street, has been let to J. Villeneuve, 64 Bayswater Avenue. Approximate cost, $4,000.

Port Credit, Ont.
The contract for plumbing and heating required in connection with the residence now being built by W. N. Allin, 19 Balmuto Street, Toronto, has been let to J. H. Doughty, Lake Shore Road, Mimico.

Quebec, Que.
Work has been started on the erection of a residence for Madame H. R. Dussault, 163 Fifth Street, Limoilou. General contractor, Maxime Picotte, 161 Fifth Street, Limoilou. Brick and frame construction. Estimated cost, $7,000.

The general contract for the erection of an addition to a residence for Brown & Rochette, 480 St. Valier Street, has been awarded to A. Des Lauriers, 402 St. Francois Street. Approximate cost, $4,000.

Work has been started on an addition to a residence for E. Tremblay, 100 Cremazie Street. General contractors, Parent & Lachance, 7 St. Marie Street. Approximate cost, $3,000.

St. Thomas, Ont.
The general contract for the erection of a residence for T. H. Walley has been awarded to Horton Brothers, the carpentry to D. L. Shafer, 131 Curtis Street, and wiring to Sandham & Roberts, 531 Talbot Street. Approximate cost, $3,000.

Toronto, Ont.
R. Dale, 96 Castle Frank Avenue, has commenced the erection of a residence, and has let the heating and plumbing to J. Elliott, 98 Concord Avenue. Brick construction. Estimated cost, $4,000.

In connection with the residence being built by Hayward & Whitehorn, 6 Hallam Street, the heating has been awarded to A. Pountney, 361 Ossington Avenue, and the plumbing to F. Adams.

The general masonry and carpentry contracts for an addition to the residence of J. G. Caven, 88 Bloor Street E., have been let to James McKenzie, 447 Gladstone Avenue, and work has been started. Estimated cost, $3,500.

The contract for masonry required in the erection of a residence on Oakmount Road for H. Fussell, 201 Howard Park Avenue, has been let to Albert Webb, 13 Shirley Avenue, and the carpentry to E. E. Woodley, 5 Poplar Plains Crescent.

In connection with the residence which is being built on Glengrove St. E., for W. B. Galbraith, 22 St. Leonards Avenue, the contract for masonry and plastering has been let to F. Bailey, the carpentry to J. Tait, 58 Manor Road, heating to W. Schulkins, 932 College Street, and plumbing to A. Wilson. Approximate cost, $7,500.

Ireland Brothers, 118 Belleview Avenue, have been awarded the general contract for the erection of a residence and garage for Harton Walker, 20 Toronto Street, and have started work. Approximate cost, $10,000. Brick construction.

Verdun, Que.
Work has been started on the erection of a residence for John Hunt, 602 Rielle Avenue. General contractors, Anglins, Limited, 65 Victoria Street, Montreal. Brick construction. Estimated cost, $3,500.

Westboro, Ont.
In connection with the residence being built by F. Labounty, Roxborough Avenue, the contract for electrical work has been let to C. C. Gould. Brick veneer construction. Approximate cost, $3,000.

Windsor, Ont.
In connection with the erection of flats for Mrs. G. Hallett, Langlois Avenue, the contract for masonry has been let to Alfred Cross, Louis Avenue, the plastering to N. Troup, 213 Victoria Road, Walkerville, and heating, plumbing and steel to L'Heureux Brothers, 12 Wyandotte Street E.

The following contracts have been let for the erection of a residence for S. E. Rigg, 35 Pitt Street E.:—masonry and

Tenders and For Sale Department

To Contractors

Sealed tenders will be received up till noon, **April 26th, 1916**, by the Secretary, for the erection and completion of a six-roomed Public School Building for Finch School Board Section No. 3, in the Village of Finch, Ont.

Drawings and specifications can be seen at the undersigned. The Board reserves the right to reject any or all tenders. The successful tenderer will be required to furnish satisfactory guarantee as to good faith. Tenders will be opened after 8.30 o'clock p.m. May 1st.

GEO. S. CASSELMAN,
Secretary.

16-17

Tenders for Bridge

Tenders will be received and contracts awarded by the Council of the Township of Blandford at the Commercial Hotel, Woodstock, on **Saturday, the 29th day of April**, at the hour of 2 p.m., for the construction of a 40-foot steel girder span with concrete floor and abutments, at Ratho. Tenders may be separate or in bulk, and may be addressed care of:

F. J. URE, C.E., Woodstock, Ont.
GEORGE OLIVER, Twp Clerk, Bright.
EDWARD ADAMS, Reeve, Woodstock.

16-16

Sealed tenders addressed to the undersigned, and endorsed "Tender for metallic fittings for New Customs Offices and Examining Warehouse, Sussex Street, Ottawa," will be received until 4 p.m., on **Thursday, April 27, 1916**, for the work mentioned.

Plans, specification and forms of contract can be seen and forms of tender obtained on application to the office of Edwin Francis, Caretaker, Post Office, London, Ont., R. L. Deschamps, Overseer of Dominion Buildings, Post Office, Montreal, Thos. A. Hastings, Clerk of Works, Postal Station "F," Toronto, and at this Department.

Firms or others tendering are hereby advised that two separate tenders are to be submitted; one to cover filing cases, etc., the other to cover shelvings, etc.

Persons tendering are notified that tenders will not be considered unless made on the forms supplied, and signed with their actual signatures, stating their occupation and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honorable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, April 13, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—148.

16-16

Construction of Cribwork and Concrete Wall

Sealed tenders will be received up to 12 o'clock noon, **Monday, May 1st, 1916**, addressed to the Chairman of the Toronto Harbor Commissioners, 50 Bay Street, Toronto, Ont., and marked "Tenders for Harbor Head Walls."

All information may be obtained by applying to the above address. Tenders received after the time above named will not be considered.

The Commissioners reserve the right to reject any or all tenders received.

E. L. COUSINS,
Chief Engineer and Manager.

16-17

Tenders for Drainage Work

Sealed tenders, addressed to Alex. McFarlane, Clerk of the Township of South Norwich, Otterville, will be received up to 7.30 p.m., of **Wednesday, the 10th day of May**, for the construction of "The Collver Drain" 9,817 lineal feet of tile drain and 1,475 lineal feet of open drain.

Tenders for the supply of tile, F.O.B. Hawtry, will be received at the same time. Plans and specifications may be seen at the Clerk's office, Otterville, or at the office of the undersigned, Woodstock.

16-16 F. J. URE, Township Engineer.

Tenders Wanted

Sealed tenders will be received by the undersigned, addressed to Chester S. Walters, Esquire, Mayor, Chairman Board of Control, up to 5 o'clock p.m., **Monday, the Eighth day of May, 1916**, for supplying mechanical rakes and appurtenances for Gage Avenue pumping station.

Tenders to be on forms supplied by the City Corporation and plainly marked on the outside as to contents.

Plans, specifications, and further details can be obtained upon application to the City Engineer's office, Hamilton, Ont., Canada.

The lowest or any tender not necessarily accepted.

S. H. KENT,
City Clerk.

Hamilton, April 11th, 1916. 16-16

Notice to Contractors Sidewalk Plant

Sealed tenders, addressed to the Chairman and Members of the Board of Control, will be received by the Secretary of the Board of Control, City Hall, Ottawa, up to 4 p.m., **Tuesday, April 25th**, for the supply and delivery of:—

One 1/3 cubic yard batch power Concrete Mixer.
1,500 lin. ft. complete, of steel sidewalk forms.

Any tender received after the above stated time will be declared informal.

Specifications and full particulars may be obtained on application to the City Engineer's Office, City Hall, Ottawa.

The Corporation does not bind itself to accept the lowest or any tender.

F. C. ASKWITH,
Acting City Engineer.

Ottawa, April 14th, 1916. 16-16

To Contractors

Sealed bids for all trades required in the erection of a residence in Warren Road, Toronto, will be received up to noon of **Saturday, April 29th, 1916**. Plans and specifications, and all particulars may be obtained at the office of the architect.

The lowest or any bid not necessarily accepted.

F. S. BAKER, Architect,
Traders Bank Building,
Toronto, Ont.

16-16

TENDERS

Tenders for all trades in connection with the erection of addition and alterations to St. Peters Separate School and a new School at St. Monica's Parish, for the Separate School Board for the city of Toronto, will be received until 5 p.m., **Wednesday, April 26, 1916**, at the office of the Board, 67 Bond Street.

Tenders to be submitted on forms supplied by the Architect, and to be addressed to E. F. Henderson, Chairman of Sites and Buildings Committee, and must be accompanied by a marked cheque for **10** per cent. of the amount of tender.

Plans and specifications may be seen at the office of the Architect, Charles J. Read, Rooms 137 and 138 Confederation Life Building, Toronto.

16-16

Tenders for Bridge Construction

Sealed tenders, plainly marked as to contents, will be received by the undersigned up to 12 o'clock noon of **Thursday, April 27th, 1916**, for the construction of a reinforced concrete bridge of 25 ft. span on the East Boundary of Lot 21, Con. A, fronting the Humber River in the Township of Etobicoke, known as the Culham Bridge.

Plans and specifications may be seen at the office of the undersigned, 57 Adelaide St. East, Toronto.

The lowest or any tender will not necessarily be accepted.

FRANK BARBER,
Township Engineer.

Toronto, April 7th, 1916. 16-16

TENDERS for Steel Furnishings at the New Registry Office

Tenders required in connection with work on the above will be received by registered post only, addressed to the undersigned up to noon on **Tuesday, April 25th, 1916**. Plans and specifications may be seen and forms of tender and all information obtained at the office of the City Architect, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. The usual conditions relating to tendering, as prescribed by the City By-laws, must be strictly complied with or tenders may not be entertained. Tenderers shall submit with their tender the names of two personal sureties or the bond of a Guarantee Company, approved by the City Treasurer. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman of Board of Control.

16-16

Residences

(Continued from page 49)

carpentry, J. R. Scullard; plumbing and heating, Roy Hicks, 159 Wyandotte Avenue E. Street E.; plastering, Nicol Troup, 213 Victoria Road, Walkerville; roofing, Windsor Hardware Company, 71 Sandwich Street E.; electrical work, W. A. LeFave. Approximate cost, $8,000.

Power Plants, Electricity and Telephones

Mono Mills, Ont.
The Mono Mills Independent Telephone Association, Ltd., have been incorporated to construct a telephone line in the Townships of Adjala, Caledon, Mono and Albion. W. J. Miller is interested.

Rodney, Ont.
The Town Council will submit a by-law to authorize the installation of a lighting and power distribution system. Estimated cost, $7,000. Clerk, S. B. Morris.

Saskatoon, Sask.
The City Council will require 2,500 feet of 4-core lead covered wire and power cable. Electrical Engineer, E. Hanson.

St. Emelie De L'Energie, Que.
The installation of an electric lighting system is contemplated by Evangeliste Lagacee. Approximate cost, $50,000.

Strathroy, Ont.
The Town Council are considering the installation of an electric fire alarm system. Clerk, F. W. Atkinson.

Weyburn, Sask.
A by-law has been carried authorizing the raising of $35,000 for the purchase of one 500-k.w. turbine and equipment. Engineer, George W. Reid.

CONTRACTS AWARDED

Ottawa, Ont.
The City Council have let the contract for supply of underground cable to the Standard Underground Cable Company, Sherman Avenue N., Hamilton, at $10,600.

Miscellaneous

Kirkland Lake, Ont.
H. Oakes, Lake Shore Mine, will receive tenders immediately on the supply of one 200-h.p. motor, compressor, drill and pumps.

Ottawa, Ont.
The Board of Control will receive tenders until April 25th for the supply of one concrete mixer with a capacity of one-third yard.

Ottawa, Ont.
The Department of Railways & Canals will receive tenders until April 18th on the supply of 42,000 barrels of cement. Specifications at office of the Purchasing Agent.

Preston, Ont.
The Town Council are considering the purchase of a steam or chemical fire engine. Clerk, H. C. Edgar.

Sherbrooke, Que.
The City Council are now receiving tenders for one piston power pump, capacity 4,000,000 Imperial gallons, triplex power, horizontal or upright, with outside packing, to work against a 250-foot head. Secretary, E. C. Gatien.

The City Council will receive tenders until noon, April 29th, for the following machinery:—one piston power pump, one vertical water wheel, flume, shaft and brackets. Specifications at office of the City Engineer, Thomas Tremblay.

Toronto, Ont.
The Toronto Harbor Commissioners, 50 Bay Street, will receive tenders until May 1st for the construction of crib work and concrete wall. Chief Engineer, E. L. Cousins.

CONTRACTS AWARDED

Berlin, Ont.
The City Council have let the following contracts for supplies:—iron piping, J. Hainsworth, 14 Foundry Street N.; sewer pipe and cement, R. Boehmer & Company, 78 King Street E.; catch basins and manhole covers, Farwell Foundry Company, 225 Queen Street; concrete tile, P. Bergman, King Street, Waterloo; curb iron, A. B. Miller, Berlin.

Brantford, Ont.
The City Council have awarded the contract for the supply of road oil to the Crescent Oil Company, Limited, 136 Cannon Street West, Hamilton.

Galt, Ont.
The City Council have let the following contracts for supplies:—castings, Galt Foundry Company, Stone Road; hardware, Buchanan & Tait, Main Street; cement, I. D. Burns, Main Street, and Scott & Hogg, Water Street S.; lumber, W. I. Reid Company, Water Street N.

London, Ont.
The London Concrete Machinery Company, Ltd., have awarded contracts for the supply of machinery to the following firms:—Sparks & McKay, Hamilton; William Fralick, Wellandport; Globe Graphite Mining & Refining Company, Port Elmsley; J. C. Hunt, Dorchester; Dominion Steel Metal Company, Hamilton; Corporation of Village of Ormstown, Que.; George Bannister, Ottawa; J. E. Tomlinson, Malton.

Quebec, Que.
The City Council have let the following contracts for supplies:—pig lead and lead pipe, Charles A. Parent, 106 St. Joseph Street; cast iron pipe, Canada Foundry Company, 162 St. Antoine St., Montreal; iron and brass castings, F. X. Drolet, 206 De Pont Street, and Terreau & Racine, 196 St. Paul Street; brick, W. Cantin, Les Saules Street; clay pipe, Standard Clay Products Company, St James Street, St. John's, Que.

Fires

Ange-Gardien, Que.
Stable and barn owned by Joseph Letarte. Loss, $3,000. Will rebuild.

Aylmer, Que.
Residence of Herbert Routliff. Loss, $5,000. May rebuild.

Brooke Township, Ont.
Barns owned by Robert Toohill, Napier. Will be replaced by fireproof structures.

Chateau-Richer, Que.
Sawmill owned by J. Cauchon. Loss, $7,000. Will rebuild.

Drumheller, Alta.
Business block owned by W. E. McDonald. Loss, about $10,000.

Highfield, N. B.
Store and residence of Tobias Brothers. Loss, about $5,000.

Killarney, Man.
Plant of the Crescent Creamery Company, Ltd., Sherburn Street, Winnipeg. Loss, $5,000.

Lion's Head, Ont.
Store of Tackaberry & Tackaberry. Loss, $15,000. Owners considering rebuilding.

Napinka, Man.
Warehouses owned by James Carnduff. Loss, $6,000. Will rebuild.

Ottawa, Ont.
Residence of L. Charbonneau, Holland Avenue. Loss, $3,000.

Russell, Man.
Premises of the Union Bank of Canada. Loss, about $15,000. Manager, W. W. Barry.

St. Adalbert, Que.
Sawmill owned by Albert Caron. Loss, $4,000.

Ste. Foye, Que.
Residence owned by Ernest Myrand, 144 Latourelle Street, Quebec. Loss $4,000. May rebuild.

St. Hyacinthe, Que.
Hotel, owned by P. Jubinville. Loss, about $8,000. Will rebuild.

St. John, N. B.
Business block owned by the McLean Estate. Loss, $5,000.

Moulding shop of McLean, Holt & Company, Ltd. Loss, about $4,000. Manager, D. J. Barratt.

St. Lazare, Que.
Store and residence of Oscar Lavigne. Loss, $15,000. Will rebuild.

St. Paul du Buton, Que.
Sawmill owned by A. Blais and F. Letourneau.

St. Thomas, Ont.
Residence owned by Duncan Wrightman, c|o Pere Marquette Railway. Loss,

Business block owned by E. Morrissette. Loss, about $30,000.

Late News Items

Berlin, Ont.
The contract for laying about 6,000 square yards of concrete pavement with curbs and gutter has been awarded by the City Council to Ernest J. Holland, Ingersoll, at $8,742.

Brantford, Ont.
Tenders on the erection of a residence for E. L. Gould, 103 Darling Street, will be received until noon, April 22nd, by the Architects, Barber & Tilley, Temple Building. Approximate cost, $8,000.

Brockville, Ont.
The General Hospital Board have let the contract for masonry, carpentry and steel work required in the erection of a Home to A. Cameron, Alexandria. Approximate cost of building, $77,000.

Cottam, Ont.
The Secretary to the Gosfield Township Council, W. H. Noble, Cottam, will receive tenders until April 29th, for (1) drilling an artesian well and supply of castings, ets., and (2) drilling only.

Dartmouth, N.S.
The general contract for the erection of a foundry for the Williston Steel Foundry Company has been awarded to Rhodes, Curry & Company, Limited, Kempt Road, Halifax. Approximate cost, $16,000.

Halifax, N.S.
The following are contractors for the apartments now being built for F. A. Shaw, 32 Blower Street:—general contract, masonry, carpentry and roofing, J. D. Lavers, 1 Argyle Street; heating, Andrews Heating Company, Minneapolis; plumbing, C. H. Cragg, Water St.; electrical work, J. Starr Son & Company, Granville Street. Approximate cost, $10,000.

Montreal, Que.
The Protestant Board of School Commissioners, Belmont Street, have awarded the general contract for the erection of a school on De Jumonville Street to the Raymond Construction Company, Limited, 145 St. James Street. Approximate cost, $6,700.

Quebec, Que.
W. Brochu, 87 Claire Fontaine Street, has commenced the erection of a residence on Aberdeen Street, estimated to cost $7,000. Brick and frame construction.

Work has been started on a building for the Y. W. C. A., 125 Ste. Anne Street. The contract for excavation has been let to the Sharp Construction Company, 109 Fleurie Street. Tenders will be called shortly for the erection of the building. Estimated cost, $50,000.

St. Christophe Pont Viau, Que.
Vautrin & Bernier, 281 St. Andre St., Montreal, will receive tenders until April 28th for the erection of a chapel and parsonage.

St. Maurice de Thetford, Que.
The contract for interior alterations to the Roman Catholic Church has been awarded to J. St. Hilaire, St. Romuald, Que., at $35,000.

Toronto, Ont.
The plans for the proposed Masonic Temple on Spadina Road have been revised, and the cost reduced to about $175,000. The Directors expect to call for tenders shortly. Architect, H. B. Knowles, 1170 Broadway, New York City.

Wood Coffer Against Back of Dam Used in Replacing Masonry

Two temporary spillways left in constructing the La Boquilla dam of the Northern Mexican Power Company, Limited, were closed under a considerable head of water by constructing timber shutters across the upstream openings, building a rubble masonry wall across them and filling the space between wall and shutter with concrete in which large stones were bedded. The masonry placed in this space was laid under water, as the shutters could not well be made tight. The east spillway was deeper than the west, and the masonry proved so porus that it was not practicable to grout it. G. G. Underhill, chief engineer, and Edwin Duryea, Jr., consulting engineer for the power company, then decided to replace the back face of this masonry, doing the work in a timber cofferdam seated against the back of the dam. The method is described by them in a recent issue of the Cornell Civil Engineer.

The construction of the dam, which is in the State of Chilhuahua, Mexico, had been delayed by the difficulty of securing cement. Meanwhile the reservoir filled so that at the time the 33-foot-wide east spillway was closed it was passing water at a depth of 20 feet. The volume of water descending into the gorge below at high velocity menaced the foundations of the power house, 140 feet below the spillway floor. By the time it was decided to remove the porous masonry from the back of this spillway section cement had been secured, the dam had been carried considerably higher, and the reservoir had filled to about 33 feet above the bottom of the section to be repaired.

A cofferdam 46 feet high and braced with horizontal I-beam stringers inside vertical studding was used. Over the latter were nailed two layers of 2-inch plank covered with canvas. Because there was no site convenient for a launchway, the studding, floor and lower part of the sheeting were assembled on shore and handled to place by the two cableways spanning the dam. The cofferdam was completed in place and lowered a few feet at a time as it was built up. On reaching the required depth, the sides and floor of the cofferdam were caulked against the back face of the dam with bags, etc., by a diver. Several vertical cross walls of three 2 x 12 inch 40-foot timbers each were then set and wedged against the I-beams by the diver. These were found far easier to place than crossbraces, and were considered much superior. During the building of the cofferdam it was hung on two 1-inch wire ropes fastened to the floor near the upstream edge and clamped off around blocks hung from eyebolts in the masonry above. These lines pulled the bottom of the cofferdam against the masonry, while the top was held in by short side lines fastened to eyebolts on either side of the section. The lowering was done by two stiffleg derricks, set one on each side of the old spillway, helped when necessary by the cableways. The floor of the cofferdam was weighted with stone to help sink it.

When the cofferdam was in place and braced it was unwatered with three 8-inch centrifugal pumps. As the water was lowered, inclined timber struts were placed from notches in the masonry to blocks bolted to the studs. They were required in addition to the friction of the cofferdam against the masonry to overcome the uplift.

The coffer once pumped out, the work of removing the defective masonry to an average depth of a yard and replacing it with good concrete was readily accomplished, working from the bottom up. This wall provided a solid backing, enabling the interior part of the porous section of concrete to be grouted without difficulty.

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Principal Contents

Good Roads in Peace and War

THAT good roads are an indispensable asset to any country is being fully demonstrated by the present European war. Engineers generally have recognized that good roads are a military asset, but few have fully realized the momentous part being played by good roads in the outcome of the present war. They were probably the determining factor in stopping the great German drive early in the war on Paris. General Joffre, by the aid of motor transports, taking advantage of the splendid highway system around Paris, concentrated forces at strategic points with such rapidity that he was able to check the German drive and prevent the investment of Paris by the Teutonic invaders. By commandeering all available motors he was able to transport during the days previous to the battle of the Marne a steady stream of soldiers night and day, which was effective in turning the tide of invasion.

* * *

Again, the Kaiser's stupendous drive on Verdun, when that strategist launched his human battering ram against the great French fortress, was apparently defeated by the mobilization of sufficient French troops and munitions by vehicular traffic over well-maintained highways with sufficient rapidity to withstand the fiercest onslaught in the history of human warfare.

Add to these the conditions necessary to bear the heavy traffic transporting modern artillery, ammunition columns and the great number of fast-moving motor transport trucks, the strain of which may be partly realized when one remembers the millions of men to be fed daily with both food and shells. The nature of the surface required to withstand such traffic indeed must be of a most permanent nature. This volume and weight of traffic is such as to justify and require only the most substantial of roads, surfaces permanent enough to bear the shearing action of these heavily-laden, fast-moving trucks. Traffic must move quickly; the ever-present watchful eye of the enemy, the air-craft, are always ready to detect any traffic on highways and the slow-moving, mule-drawn transport which had its place in the South African campaign would only furnish good bomb practice in the present conflict.

The same argument, though in a less degree, proves the superiority of motor transport over steam roads. The steam line, being fixed in position, is a much easier target for air-craft and a tie-up must cause much greater and more prolonged delay.

* * *

Indeed, the present conflict appears to bring home to us sharply the strategic value of good military roads which appear to outweigh that of railways from a military point of view. Railways are much more easily demolished, harder to repair, and not nearly so flexible, especially in a rough country. Added to this there are generally many parallel roads, leading to the same destination, any one of which could be utilized in case another is destroyed. In modern warfare, where two large, well-equipped armies, of practically equal strength, battle, success is generally going to come only by applying at the crucial moment a strong, well-mobilized force at the weakest point in the enemy's lines. To do this, mobility and rapidity of movement in all directions is the essential feature, and here the great tactical value of the improved highway in lessening the fatigue of forced marches and increasing the effective radius of action, is appreciated.

Considering, then, how good roads conduce to the wealth of a country in peace times, as well as to the national defence in war time, the plea for more improved highways seems amply justified.

Architects' Association Has Not Exclusive Rights

An important decision respecting the Association of Architects of the Province of Quebec has just been handed down in the Court of Review by Acting Chief Justice Archibald and Justices McDougall and Mercier.

It appears that a Mr. Gariepy had transgressed the rules of the Association of Architects of the Province of Quebec by giving himself the title of architect without first becoming a member of the association. The association took the matter up, and the Supreme Court some time ago confirmed a ruling of the association which condemned Mr. Gariepy to pay a fine of $100. The Court of Review now reverses the judgment of the Supreme Court, and in so doing denies the Association of Architects of the Province of Quebec the right to exclude architects who are not members of their association from practising in Quebec.

The following extract from the recent judgment indicates clearly the attitude of the Court of Review on this question:—

"To justify plaintiff's conclusions we would have to rely upon inference and implication to agree to the proposition that the provincial architects' association is a close corporation—that the charter under which this action is brought gives the Association of Architects the exclusive right for their members to practise as architects in this province and to bar out all others who do not join their ranks. We cannot subscribe to such doctrine.

"The privileges afforded the association are stated in the terms of the statute—neither more nor less. By inference, we are now asked to decide that because the Bar, the physicians, notaries, surveyors and certain other professions have obtained exclusive charters wherein the prohibitive enactment is expressed in clear and unmistakable terms, the Legislature intended to do the same thing for the profession of architects, although the language used in the Architects' Act presents serious points of difference from the simple, direct and plain phraseology of these other acts.

"If such was the intention, why not express it? The fact that it was not so expressed is apt to lead one to the presumption that the law-giver did not intend to grant exclusive rights here. Coupled with the further circumstance that the architects when applying for and obtaining their charter, as well as the legislators upon granting it, had before their eyes and in their minds the charters already granted to the said other corporate entities, what conclusion are we to draw when we see them departing from well-known, symmetrically-drafted, bomb-proof models, to ask for and receive a version so at variance therefrom?"

The Sanitary Service at the Front

Writing in the London Times on the R.A.M.C. service in Flanders, Dr. Grenfell, of Labrador, who has been working with a Canadian unit, says:—

"The sanitary services of all the towns and villages near the line have been taken over entirely by the R. A. M. C. Sewers and drains have been put in order; garbage and filth disposed of at the least possible cost. At certain places near the line one sees a series of furnaces all made from old tins filled with clay, having air spaces between, which once lighted require next to no attention, but are eternally doing their work, like modern 'Valleys of Hinnom.' Water supplies are all the while being tested and retested by ambulatory laboratories. One sees everywhere the trail of their work in labels hanging to melancholy looking taps, such as 'This water is not to be used until chlorinated.' It is at best a muddy fluid that serves for trench tea. Yet at the front there is is less typhoid than measles.

"The happiest men we saw in France were in the baths close behind the trenches. In one converted dyeing factory 2,000 men got baths in a day. One saw batches of men rolling about in the huge vats filled with clean hot water, while their uniforms in superheated steam chests and under heavy hot irons were being freed from the plague of trench vermin, and entirely new sets of well-aired underclothing were being put out for each man. The splendid physique of the men, as one viewed these regiments in statu naturae before they returned once more to the battle line, suggested the pathos of the preparations of the Spartans before their 'field of honour' at Thermopylae. Yet to be of service these prophylactic measures have to be conducted so close to the firing line that just before we entered 'the baths' a stray 'Jack Johnson' lopped over fussily past the side entrance into the canal that furnishes its water supply. The lot of a washerwoman is not looked upon as heroic in civil life, but anyone inspecting the conditions under which the laundries close behind the lines carry on their warfare, with the essential coverings of a trench army, would find no reason to grumble if an occasional decoration fell into the hands of some of the leaders of these tireless hosts."

Ottawa Branch C.S.C.E.

At the meeting of the Canadian Society of Civil Engineers, Montreal, on the 13th inst., Mr. John Murphy, chairman of the Ottawa branch of the Society, gave an informal talk on a visit to the Panama Canal. By means of slides, Mr. Murphy described in particular the earth slides in the Calebra cut, referring to the manner in which the earth was forced up from the bottom of the canal, the means taken to remove the enormous masses which obstructed the waterway, and the difficulties which were encountered by the engineers. Afterwards Lieut. Col. F. A. Snyder, a member of the society, gave an address on map making and map-reading in military work. He described an original diagram for making military scales for interpolation of contours and the reduction and enlargement of maps, a method which has been adopted by the Canadian Militia Department.

Proceeding with Construction Work

The Montreal Board of Control has decided to proceed with the completion of the north wall and the construction of the south wall in connection with the aqueduct scheme and the new filtration plant. Plans are also being prepared for the new power house required for the proposed hydro-electric development portion of the scheme, by which power will be provided for pumping and lighting purposes.

Collingwood Adding Waterworks Equipment

The Board of Water Commissioners of the town of Collingwood have awarded the Turbine Equipment Company, Toronto, a contract to supply and install two De Laval single stage centrifugal pumps, each having a capacity of 1,000 Imperial gallons a minute, against 165 feet head, and each direct-connected to a 75 h.p. Canadian Crocker-Wheeler motor, complete with valves, piping and Venturi meter.

Work on the nave of the Episcopal Cathedral of St. John the Divine, in New York City, which will be the largest church in the United States, will begin May 8. The work is expected to take 5 years and to cost nearly $3,000,000.

The 10th report of the Board of Railway Commissioners for Canada, covering the year ending March 31, 1915, is just to hand.

Shall I Build Now, or Wait? Comparative Prices To-day and at Outbreak of War

(Continued from April 19)

Stone and sand—Prices somewhat easier.
Brick—Fully twenty-five per cent. drop.
Cement—Reduction of 10 to 15 cents a barrel.
Lime—Exactly same.
Lumber and millwork—Same, or slightly in advance of 1914; considerably lower than 1912-13.
Hardwall plaster—No advance.
Plumbing and heating—A considerable advance in nearly all metal prices.

This sums up the situation so far as we have been able to gauge price conditions in our last three issues. A number of miscellaneous items remain which are of more or less importance, such as paints, glass, roofing, etc. Discussion on these follow:

Fireproof Doors, Windows, Sash, Etc.

The A. B. Ormsby Company, Toronto, have supplied us with the following data regarding prices of metal doors and windows:

"In connection with hollow metal sash the price of iron has been steadily advancing and today we are paying about $3.00 more per cwt. for it than we were when the war broke out.

"In connection with steel sash—Any manufacturer that has not a heavy stock on hand at the present time will find it impossible to get section, as the Steel Trust are so busy they do not know what to do. The price on this has also been steadily advancing.

"Regarding fireproof doors, tin plate has gone up in sympathy with the other metals, and on account of the scarcity of lumbermen the price of timber has gone up, so that there is a considerable increase in the price of fireproof doors.

"Labor is getting scarcer every day and the quality poorer, the result being that it costs considerably more to make up the goods today than it did at the beginning of the war or a year ago."

Papers and Felts

The enemy found us unprepared in more ways than one. We had been satisfied to purchase a number of items of commerce from Germany because the cheap labor conditions of that country prevented our competing with them in cost of manufacture. Such items, for example, were bleaching and dyeing materials. The increase in cost of the analine dye, which has made itself so indispensable during the past ten years, figures out at more than 10,000 per cent. Bleaching materials have advanced about 1,000 per cent. Fortunately these items do not bulk large in the building trade, but manufacturers of ready roofing, wallboard, felt, etc., used in building have advanced their prices sharply and are taking orders for immediate shipment only. The following figures covering ingredients which enter into the manufacture of these articles show clearly the reason of the advance in price (Table I.) For these figures we are indebted to Messrs. Bird & Son, Hamilton, Ont.

Table I.

		Before the War	Mar. 1, 1916
Roofing rags	per cwt.	.85	$3.12
Alum	per cwt.	.95	4.75
Bleach	per cwt.	1.30	12.00
Soda ash	per cwt.	.65	4.00
Starch	per cwt.	1.79	2.05
New colored cuttings	per cwt.	1.40	3.50
New dark cuttings	per cwt.	1.00	3.00
Flax waste	per cwt	1.60	5.00
Sulphate pulp	per cwt.	1.75	3.05
Sulphite pulp	per cwt.	1.60	3.00
Bleached sulphite pulp	per cwt.	2.60	4.50
Mixed papers	per ton	5.00	10.00
Folded news	per ton	6.00	12.00
Kraft papers	per cwt.	1.00	2.30
Analine dyes	per lb.	.27	30.00

Metallic Roofing

Prices of most lines have advanced from 10 to 25 per cent., metallic ceiling material alone remaining at the old figure. The following table (Table II.) shows the relative cost of materials to-day as compared with August 4, 1914. These figures were kindly furnished by the Metallic Roofing Company of Canada, Toronto, who state that unless steel and spelter show a decline in the near future these prices must further advance.

Table II.

		Aug. 4, 1914	To-day
Galv. "East Lake" Shingles	per sq.	5.00	5.50
Painted "East Lake" Singles	per sq.	3.50	3.75
Galvanized Siding	per sq.	3.95	4.45
Painted Siding	per sq.	2.75	3.00
28 G Galv. Corr.	per 100 sq. ft.	4.00	5.00
22 G Galv. Corr.	per 100 sq. ft.	6.75	8.50
28 G Painted Corr.	per 100 sq. ft.	3.00	3.25
22 G Painted Corr.	per 100 sq. ft.	5.25	5.75
Metallic Ceiling	per sq.	4.00	4.00
10-in. O. G. Trough	per 100 ft.	2.97	4.15
3-in. Conductor Pipe	per 100 ft.	3.90	5.22

From the above information it is plain that under the heading of "Miscellaneous" we encounter a number of items that cost appreciably more than they did a few months ago. Whether these increases are offset by the gains at other points, or whether they can be balanced against the general willingness of contractors to do business these days on a very narrow margin, can only be determined when the exact conditions surrounding any individual case are known. Looking at the matter superficially, it seems to be quite possible that this may be the case. Further items under "Miscellaneous" will be considered in our next issue.

(To be Continued.)

What promises to be an important new development in roofing material for homes, is being shown by Bird & Son, Hamilton, Ont., who operate the largest factory for roofing and wall boards in Canada. It consists of an asphalt-saturated felt base with crushed slate surface, and made twice the size of an ordinary shingle. It is claimed for the shingle that it is not only as handsome as slate, but that it is economical as to cost, very durable, resists fire, and is easy of application on account of uniform size. The new shingle is being marketed in conjunction with this firm's paroid roofing and Neponset wall board.

The Construction of Highway Bridges

More Careful Consideration of Bridge Design and Construction as a Factor in Improved Highways

By Lucius E. Allen*

A consideration of any scheme of highway development must include as a component part of such system its highway bridges, which in many highways bears no small part of the total cost of the road. In view of this fact, a careful study on the part of highway officials and engineers should be given to the designing and construction of bridges that in point of cost and durability combined with the utmost safety will best conform to present and future conditions upon our highways.

While the wearing surface of the roadway will wear out and require renewal from time to time, the bridge structure should be so constructed as to be practically permanent. To attain permanency in bridges as in other structures, requires not only careful designing at the start, but also the judicious selection of those materials best adapted for that particular bridge, and finally, experienced workmanship in combining the materials at hand into a finished structure.

Substructure Design

It would be of little interest to many members of this Congress to enter into a technical discussion of the engineering of bridge design, but there are certain facts common to almost every bridge that is to be constructed, that have an important relation to the life of a bridge, which should be of interest to everyone connected with highway work. One common error often made in the construction of a bridge is the lack of attention paid to securing a good foundation. It matters not what the superstructure may be, whether of steel or reinforced concrete, unless the foundation is sound, the superstructure may be damaged beyond repair. Accurate and careful soundings should always be taken to determine the character of the bottom upon which the abutments or bridge piers will rest. This may be done by the use of steel rods driven until either solid rock or a sound foundation is found. In some cases a wash drill outfit may be used consisting of a drill point attached to short sections of iron pipe which may be connected together as the drill penetrates into the soil. Water is forced through this pipe by means of a force pump and in this way the character of the sub-soil can be determined. In rivers or streams where ice conditions are severe, it is usually necessary to trench into the rock bottom so that the pier will have proper and secure footing to withstand ice jams. This also prevents underwashing of the pier from the currents existing in the stream.

As a general rule it is not advisable to construct the arch type of reinforced concrete bridges upon anything less than a good rock foundation or its equivalent. Where the foundation conditions are not suitable for the use of the arch type of bridge, the girder-beam type of reinforced concrete may be used. In this type, should settlement subsequently occur in the abutments, the concrete slab would still be intact, the reinforced-concrete beams acting in a similar capacity to the steel girders in the girder type of steel bridge.

*Engineer County of Hastings, before the Canadian and International Good Roads Congress, Montreal.

Due attention should also be given to the size and type of piers and abutments. In some cases it is economy to use reinforcement in the piers and abutments, thereby reducing the size of the pier or abutment and adding to its strength and ability to withstand heavy lateral strains. The wing or reventment walls connected with the abutments should be constructed of such height and length as to prevent backwashing of the abutment, and also retain to a proper slope the earth approaches to the bridge. In some cases it is advantageous to start the growth of willows along the edge of the stream adjoining the wing walls to further restrict washing, etc. It is important to remember that as in many sections of this country the forests are being depleted, the watersheds of many rivers and streams, while not being changed in area, yet the spring runoff of water is much quicker than formerly, thereby increasing the danger of washouts to bridge foundations. It is therefore good practice to anticipate such conditions, and so construct the foundations of our bridges as to withstand the test of time.

Selection of Type of Bridge

Unlike highway construction, there can be no standard type of bridge that will be adapted for every locality. Local conditions should in every case govern the choice or selection of the type of bridge. This will in most cases resolve itself into a consideration of three points:—length of span and head room; character of river or stream as well as traffic conditions; and the character of the foundation available.

The length of span will depend largely on calculating the relative cost of long spans with fewer piers, or shorter spans with an increase in the cost of the foundation. The cost of the superstructure should be made to balance as nearly as possible the cost of the substructure. In some cases the lack of head room or elevation of the approaches to the bridge will prevent the adoption of the reinforced concrete arch type, in which case the girder-beam type may be used to advantage.

If steel is selected as the best material to use for a bridge, the length of span will determine the type of truss. Usually bridges with spans up to 75 to 80 feet the low truss type is the most economical, above 80 foot span the high truss type is usually used. The use of pin connected truss bridges is being displaced to a large extent to the use of riveted sections, either singly or made up of angles, channels and plates.

The girder-beam type of reinforced concrete bridge above 45-foot span is not usually as economical as the arch type. In the construction of reinforced-concrete bridges too great care cannot be exercised in the selection of the best materials entering into the concrete. Many concrete bridges have been made failures simply from the use of poor material or inexperienced workmanship. The work of pouring the concrete should be as continuous as possible, especially in the slab or rib of the arch. A careful check should be made during construction to see that every piece of steel reinforcement is placed in its proper location in the bridge. Many times a careless workman, not realizing the importance of the location of a steel reinforcing bar, will displace it from its proper location, thereby weakening for all time the strength of the bridge. Sufficient camber and grade should be given the concrete floor slab to drain the water from the bridge floor. If solid concrete side walls are used, short sections of iron pipe may be placed at the bottom of the floor and through the side wall to drain the water quickly away from the floor.

Traffic

As before stated, the character of the river or stream will in many cases determine the best type of bridge adapted for the locality, but the character and amount of traffic passing over a bridge should always be taken into consideration in determining the character and width of the bridge. While it is difficult in all cases to anticipate future traffic conditions on a given highway, on main connecting roads or roads leading into large cities or towns, the traffic is very likely to increase. For ordinary country roads, a clear roadway of sixteen feet is sufficient for ordinary traffic. For main roads, where the motor traffic is heavy a bridge width of twenty feet is not too great. In England many of the old masonry arch bridges have in recent years been widened to accommodate the large increase in traffic.

It may be of interest to note that in a report presented by Mr. H. Howard Humphreys and Mr. W. J. Taylor, County Surveyor, Southampton, England, at the Third International Road Congress in London, it is stated that of thirty-three Engineers of County Councils, who furnished information regarding the use of reinforced concrete for bridge work, eighteen reported that reinforced concrete had been used for the construction of bridges anl culverts carrying main roads within their respective counties, while others were considering its use.

The reasons chiefly advanced by these county engineers in favor of reinforced concrete bridges, as compared with steel and masonry were "economy in first cost" and "economy in maintenance." If the floor slabs of reinforced concrete bridges are kept properly covered with from five to six inches of gravel or crushed stone, there will be little wear on the concrete surface of the slab itself.

Artistic Design

The artistic design and finish of a reinforced concrete bridge should also not be neglected. With little if any additional expense artistic effects may be given to the concrete sidewalls by panels or open balustrades and suitable panelled end posts. If surfaced lumber is used for forms and the forms are removed before the concrete is too hard, the surface can be brushed and given a uniform appearance which will add much to the general effect of the bridge structure.

If steel has been chosen as the best material suited to the locality, the engineer for the municipality should prepare suitable plans and specifications which may be submitted to the various bridge builders for tender. The old practice of allowing each bridge builder to submit his own plans should be avoided, as in this way there is no uniformity of design, and many times price was the main consideration. The fabrication of the steel work should also be inspected, especially the riveted connections. While ordinary shop riveting is usually well done, the riveting done in the field in erecting the bridge is often poorly done. All rivets after being driven and inspected should be immediately painted in the field, previous to the painting of the entire bridge. Two coats of paint in the field in addition to the shop coat should be given the steel work, each successive coat being of a different color to insure every portion being covered.

Too much stress cannot be put upon the matter of painting steel bridges. Many steel bridges in Canada which when constructed were first class bridges, through neglect to properly repaint them have practically been destroyed. The speaker has examined some steel highway bridges which were constructed from twelve to fifteen years ago, which have had to be replaced by new bridges owing largely to the lack of proper painting. Steel is not often put to a more severe test than when used in bridge work, the action of moisture, water, the acids from the bridge floor, etc., all tending to contribute to rapid corrosion unless protected by paint.

Bridge Floors

The matter of the best type of floor covering for a given bridge is also of great importance. While the use of concrete as a floor covering adds greatly to the weight of the floor system, and thereby increases the size of the trusses, etc., it is generally considered to be better than wood floors on account of the lower cost of maintenance. On main highways, or in cities, a combination of concrete and wood blocks makes a very durable bridge floor. The wood blocks should be creosoted, and the joints filled with pitch or asphalt to seal the joints. One advantage of wood block bridge floors is a reduction of vibration due to traffic, as well as being noiseless.

The capacity or safe load that a steel bridge is designed to carry is an important factor, and should be given attention before designing the structure. The future traffic requirements should again be borne in mind, as it is much easier to design a bridge for a 20-ton moving load than after having been constructed to reinforce or strengthen it for increased loads. Owing to the increased use of heavy road making machinery, such as tractors, road rollers, etc., which pass over bridges, it is necessary to design the bridge to safely take a maximum load equivalent to the weight of this machinery.

Capacity

The load capacity for different highway bridges may very conveniently be divided into two or more classes, depending upon traffic, and ranging from bridges capable of carrying ten tons up to twenty tons or more, which will ordinarily be sufficient for any heavy moving load as above mentioned. Allowance should also be made for decrease in strength due to age, so that at the end of, say, fifty years, what was originally designed as a 20-ton capacity bridge, may have fallen to 15 tons loaded capacity.

There are many other details which time will not allow me to mention that must be considered in selecting and constructing a highway bridge that combines economy of design with permanency. It is, however, a source of much gratification to highway engineers, that more careful attention is being given to this important branch of highway work than formerly, and great advancement has been made within the past few years in methods of construction, so that when the construction of a great Canadian national highway from east to west is commenced, as we believe it will be, the construction of its bridges will conform in beauty and permanency with that if the highway itself.

Mail Order Building of the Robt. Simpson Co., Mutual Street, Toronto

WORK on the new Mail Order Building and Warehouse of the Robert Simpson Company, which is to be completed and ready for the fall trade, is advancing rapidly. Profiting by the splendid weather, the general contractors, Wells Brothers, have been rushing the work, and at the present time are pouring concrete on the third floor. The building is the result of the increasing demand for larger accommodation due to the growth of the mail order business.

The building is situated on Mutual Street, just north of Wilton Avenue, and occupies the whole site 279 feet by 115 feet 3 inches. It is of fireproof construction, reinforced concrete on seventy-eight concrete caissons, which go to rock, with brick panels; is eleven storeys high, and in addition has two mezzanine floors. The Mutual Street elevations on all eleven floors except the first have the concrete columns set well back from the front wall, and show an unbroken expanse of glass between the two corner towers which surmount the entrances. On the west elevation the building will back up against the old warehouse building; the concrete parapet of the old building, which is five storeys high, will be removed to roof level, the roof patched, and space between the two buildings closed off. Thus the west elevation of the new building will have windows only above the fifth storey.

The main entrance is off Mutual Street at the south end, and the employees' entrance is also off Mutual Street at the north end. The main entrance has double plate-glass doors, with a transom above, and over all a frieze with a granite name-plate bearing the company's name. The entrance vestibule, which is very spacious, has a tile floor with marble wainscot and trim. Through the entrance vestibule the lobby, also tiled floor and trimmed with marble, opens to two passenger elevators and contains the inquiry bureau.

The ground floor plan shows on the south side a paved driveway, the Retail Receiving Court, with a platform with freight elevators at each end. On the west side is a similar driveway, the Retail Shipping Court, with an 8-ft. trucking walk beside it, also paved; and on the north side the Mail Order Shipping Court, with a platform with freight elevators similar to that on the south side. The concrete columns around these courts have cast wagon bumpers, with steel guards to protect them from deterioration. A steel stack for the boiler room is built up on a concrete foundation on the south-west corner of the building.

The first floor storey is 18 ft. 1 in.; the second is 16 ft. 4 ins.; and the remaining floors 12 ft. in height. Over the area-ways on the first floor is a mezzanine floor with a 7 ft. 4 in. ceiling, and on the second floor is a similar floor. The second floor plan, which is

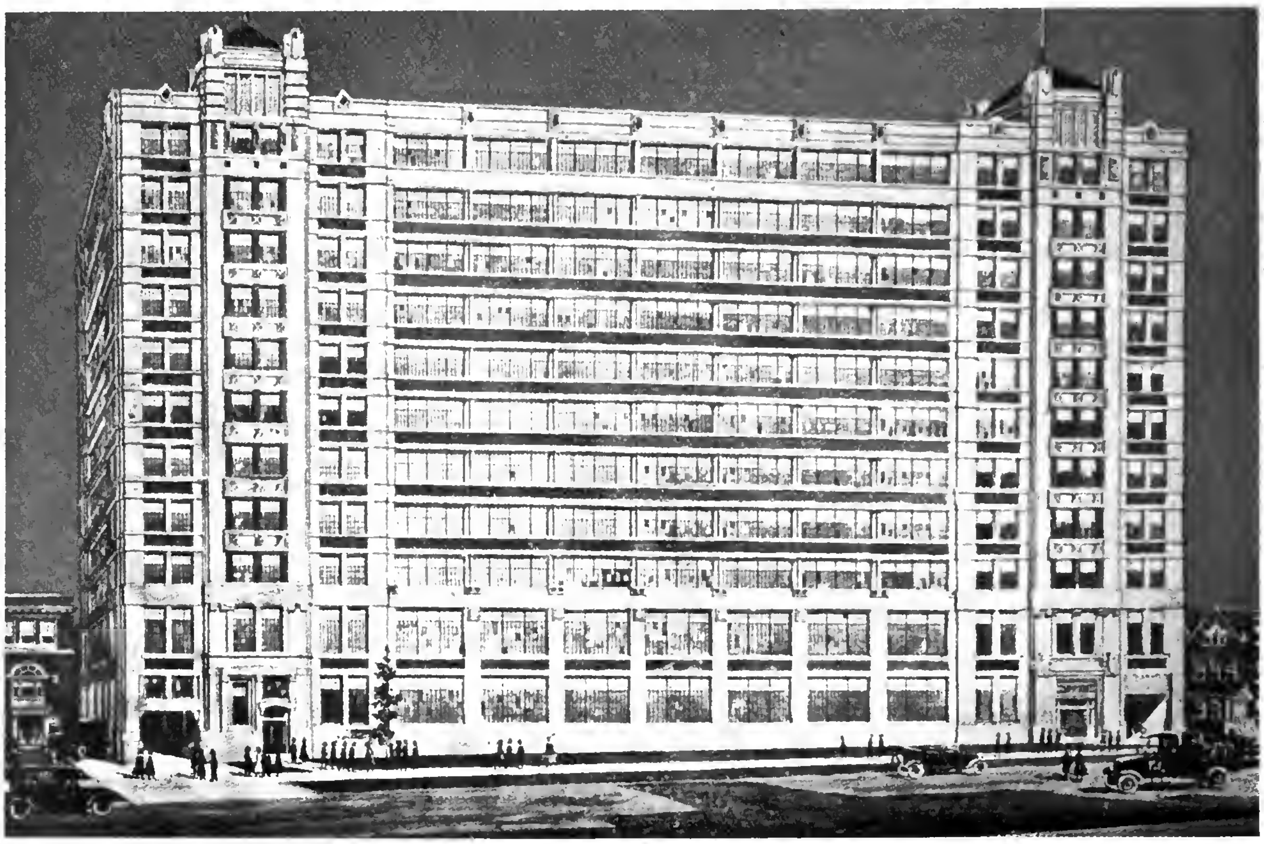

Fig. 1 The Robt. Simpson Co's. New Mail Order Building on Mutual Street, now under construction.

Fig. 2.—Ground Floor Plan of the New Robt. Simpson Mail Order Building Showing Arrangement of Foundation Piers, and Shipping Courts.

typical of the remaining floors except the top one, shows the two passenger elevators near the main entrance vestibule, with a flight of stairs beside; fire escape stairs in south-west and north-west corners inside the building; a pair of stairs leading from the employees' entrance; freight elevators at each end of the building; lavatories in the south-east and north-east corners of all floors. On the eleventh, or top, floor is the elevator machinery and the water storage tanks for the water system. There are two square 9,000-gallon tanks fed from a 40,000-gallon tank on the roof, and in addition to these two 3,000-gallon tanks in the machine rooms.

The roof is five-ply composition and gravel, 3/8 in. to 1 ft. pitch, made with 1½-in. grout on cinder fill on ceiling slabs. The roof is counter-flashed with galvanized iron, at all vertical walls and all copings are cast concrete. The four penthouses over the elevators containing the elevator machinery, have concrete floors, brick walls, moped cast concrete copings, and sky-lights. The tower roofs are built of steel angle irons covered with copper, with copper gutters.

The floors throughout the building, except the mezzanine floors, which are hardwood, are concrete. All doors and elevator doors are fireproof; steel stairs, diamond pattern, with safety tread; windows, leaded glass, steel sash; sills, cement, poured after sashes are set. The building is equipped throughout with a sprinkler system.

The building, which will cost $750,000, was designed by Max Dunning, Chicago (Burke, Horwood & White, local representatives). The general contractors are Wells Brothers, and the following subcontracts have been awarded: plumbing, heating and sprinkling, Purdy Mansell; glazing and glass, Imperial Glass Works; plastering, F. G. Roberts; ornamental iron, fireproof doors, etc., Canadian Ornamental Iron Company; elevators, Otis-Fensom Elevator Company.

The Electric Zinc Company has constructed a plant at Welland, Ontario, for the recovery of refined zinc from zinc oxide. It is intended, eventually, to treat the zinc ores from Notre Dame des Anges, Quebec, at this plant.

Contractor Offers Some Good Advice

Mr. Frank Gilbreth, the New York contractor, who built several large buildings in San Francisco after the big fire, has summarized his views on steel and concrete construction as follows:

1. A steel frame, properly painted and buried in masonry, will not rust enough in thirteen years to affect its strength any measurable amount.

2. The better the steel is coated with mortar, the less it will rust.

3. Portland cement is better than lime mortar for imbedding steel to prevent it from rusting.

4. Unpainted iron rods buried in mortar composed of lime and a large proportion of Portland cement rust very little, certainly not enough to impair their strength.

5. Columns should be of such cross section that they can be thoroughly imbedded in Portland cement, avoiding a hollow column unless latticed and filled with very soft concrete.

6. Wherever possible, preference should be given to those shapes of steel that present the least surface to the action of rust.

7. If steel is not thoroughly cleaned from rust before it is painted, the paint will not greatly retard the progress of the rust.

8. It is much easier to cover steel thoroughly with concrete than with brick masonry. If brick masonry is to be used, the bricklayer should thoroughly plaster the steel work ahead of the brick work.

9. The quality of the paint used, though important, is not so important as surrounding every part of the steel with Portland cement.

10. Interior columns do not rust as much as exterior columns.

11. Cinder concrete does not injure to the slightest degree a steel floor beam that has been painted.

12. No pipes or wires should ever be placed behind fireproofing, as they will buckle from the heat and push off the fireproofing.

Wall Plaster and Gypsum Products

The Production, Chemical Constitution, and Building Properties of Gypsum

Gypsum, the material used so extensively at the present time in building construction, chiefly for wall plaster, was the main subject of a paper on "Plaster and Gypsum Products," delivered by S. G. Webb, secretary of the Gypsum Industries Association, Inc., before the New York State Builders' Supply Association. Mr. Webb's paper deals with gypsum, its occurrence, its composition, its manufacture, its uses, and some of its products.

To begin with, gypsum is one of the oldest-known building materials and is found as the material on which mural decorations were placed in the tombs of the Califs in Egypt, erected over 4,000 years ago, and to-day, in the pyramids of Egypt it is found in the form of plastering on the surfaces of walls in the interior chambers, as solid as the stone upon which it is placed.

Gypsum is the geological name for hydrated sulphate of lime and is composed of lime in chemical combination with sulphur radical and water, the water being in the form of water of crystallization. It is found quite lavishly distributed over the earth's surface and occurs as rock, which is either in the form of veins below the ground or in masses near the earth's surface covered with only a thin layer of soil.

In the United States it is found in twenty-three states, including Alaska. The total amount mined in these states during 1914 was 2,476,465 tons. A part of this production of gypsum, amounting to 443,687 tons, was used without calcining as an ingredient for Portland cement, in paint and as land plaster. The remainder of the output was calcined and sold in the form of wall plaster or manufactured into gypsum blocks, gypsum plaster boards and other structural forms.

Production of Gypsum

In the production of gypsum, New York State produced the largest quantity, Iowa ranking second and Michigan third, and, therefore, the building supply dealers of New York State are peculiarly interested in this material for the reason that not only is it produced in the State of New York, but is produced in larger quantities in this State than in any other part of the United States.

In addition to the gypsum produced in the United States, a considerable tonnage was mined in Nova Scotia and New Brunswick and shipped to calcining mills located on the Atlantic seaboard, at New York, Newark, N.J., Newburgh, N.Y., and Chester, Pa. The quantity so imported from Canadian points amounted in the year of 1914 to 369,214 tons, making a total of material manufactured and used in the United States of 2,845,679 tons.

It will be noticed, therefore, that not only does the State of New York produce the largest amount of the domestic production of gypsum, but it also uses up the greater part of the gypsum imported from Canada in the eastern mills.

Chemical Conversion

The gypsum to be converted into plaster and manufactured articles, such as gypsum block, gypsum board, etc., has to be calcined into plaster of Paris. This is effected by crushing the gypsum rock and then grinding it to a very fine powder and placing this powder in what are known as kettles and subjecting the material in these kettles to external heat. In this way some of the water of hydration is liberated, which is approximately fourteen per cent., leaving about seven per cent. of water of hydration still remaining in the material.

The gypsum is thus converted into plaster of Paris and this plaster of Paris is mixed in mixing mills with ingredients such as wood fibre, sand, hair, retarder, asbestos fibre, or combinations of these materials, to form wall plaster. In the case of neat gypsum wall plaster, the sand is omitted. Such plaster is known as neat gypsum plaster and when the plasters are ready for use, they are known as ready mixed gypsum wall plasters.

It may be well to consider the qualifications of gypsum wall plasters, which have been responsible for the very great and rapid growth of the use of gypsum or hard wall plasters, as illustrated by the fact that the gypsum mined in the United States has grown from 90,000 short tons in 1880 to 2,476,465 short tons in 1914. Gypsum plasters must, therefore, possess distinctive merits to bring about such a wonderful increase in their use.

Qualities

I will mention some of these qualifications, not necessarily in the order of their importance, as follows:

First—Hardness; Plaster of Paris is a hydraulic cement which resumes the form of gypsum or hydrated sulphate of lime when water is added to it. It thus "sets" or becomes hard and is so hard that it will withstand a breaking pull of 100 or more pounds per square inch and this qualification of hardness acts as a valuable means of stiffening or strengthening the building in which it is used, particularly in the case of frame buildings.

Second—Sanitation; It is sanitary because of its very hardness, this hardness being throughout the entire mass of plaster, the hydraulic or setting qualities of the plaster occurring throughout its entire mass. This gives a wall surface in which injurious disease germs or objectionable insects cannot find lodgment, and it also offers an impediment through which larger vermin find it impossible to make holes.

Third—Durability; I have mentioned the fact that gypsum plaster is found to-day in perfect and hard condition as the covering of many of the walls of the chambers of the Pyramids in Egypt and that it has been there for upwards of 4,000 years. Under the city of Paris, France, gypsum is found in large quantities and has been used there for plastering and structural purposes for hundreds of years—the name of plaster of Paris being derived from this fact. This qualification, therefore, of durability of gypsum wall plasters means that they resist wear and tear in a building very efficiently.

Fourth—Quick Setting and Quick Drying; Gypsum wall plasters can be used during any time of the year, and will set and become hard and dry out very quickly, so that the owner can have the use of his building in the least possible time. He can also proceed with his painting and decorations with very little, if any, misgiving that these will be injured by too early application.

Fifth—Convenience in Handling; The fact that gypsum plasters are usually marketed packed in bags in the ready mixed form, necessitating only the plaster being mixed with water at the building, enables the dealer and the builder to handle in convenient packages only the exact amount of material that is required, and in a minimum amount of space in the building. This great convenience in handling and using has been a considerable factor in increasing the popularity of gypsum hard wall plasters, and is a very good and real reason why the dealer can handle the ready mixed gypsum wall plasters to considerable advantage.

This is a brief outline of some of the principal advantageous qualifications which gypsum wall plasters possess, about which there is no real dispute.

Corrosion of Metals

I desire to refer at this time to one question that is frequently raised as an objection to the use of gypsum plasters, and that is the assumption that gypsum tends to corrode metal. Gypsum is a neutral salt, that is, it is neither acid nor alkaline, and, therefore, cannot be corrosive when in contact with steel or iron. This statement has been amply demonstrated by experience, namely, that in the absence of damp conditions there is no corrosion of the metal when in contact with gypsum plaster. In the earlier days of gypsum plaster manufacture, however, it was the practice to use some acids as retarding agents, and it was because this acid, in conjunction with damp conditions, in some cases caused corrosion, that there grew a certain amount of prejudice against gypsum in this connection. The bugbear, therefore, of corrosion may be properly dismissed. When corrosion occurs on metal which is surrounded by gypsum plaster, it is generally found that damp conditions would bring about corrosion of the metal in any event, and whether Portland cement or lime was the plastering material used instead of gypsum. Such cases are due to the oxidation of the iron from the combination of dampness and oxygen gaining access to the metal, and are not caused by anything in the gypsum.

Is Gypsum "Noisy"?

Another question which is frequently raised as an objection to the use of gypsum plaster is that it is "noisy." The fact is that gypsum plaster is no more "noisy" than any other plastering material. I recall very well making an examination of the New England Conservatory of Music in Boston, the walls between the classrooms of which were constructed of double gypsum blocks, separated by an inch space in which was hung a sheet of Cabot's seaweed quilt. The outside faces of the walls forming the interior faces of the walls of the rooms were plastered with gypsum hard plaster. In the earlier use of this building a great deal of complaint had been made about the noisiness of these rooms by the professors conducting the musical classes, until some bright person was able to draw a distinction between echoed sound and transmitted sound. They then placed rugs on the floors, draperies at the windows and tapestries on the walls, and this reveberated sound ceased to exist; and then it was that they found that no sound whatever passed through the walls from room to room. In the designing of buildings it is frequently found that there are pipes, air ducts or openings permitting sound to pass from room to room or from floor to floor, and when such sounds are noticed, immediately the gypsum plastered walls, which are what are seen in the room, are blamed for the noise, and gypsum plaster is said to be "noisy."

I recall another case where the owner of a two-storey brick business building in a small town in Ohio improved one of the two stores on the street level and then rented it as a drug store. He put tile on the floors, covered the walls with cases with glass fronts, and put a metal ceiling over the existing plastered ceiling. After he had done all this he found that the words spoken in ordinary tones in the store were clearly heard in the Masonic Hall immediately above this room and vice versa, and so bad was this condition that the Masonic lodge contemplated cancelling its lease. The other store on the street level was a clothing store, which he did not improve. It had wooden floors and plaster ceilings, and clothing was exhibited throughout the store. Now notice the difference. No word spoken in that room could be heard in the hall above, which was occupied as a Knights of Pythias lodgeroom, and neither could any word spoken in the Knights of Pythias' room be heard in the clothing store beneath. In considering this question of sound, therefore, it is necessary to be acquainted with the conditions and find out whether there are other conditions responsible for the sound trouble. You will find that invariably there are.

Gypsum Products

I see that the subject assigned to me includes gypsum products. I hope I may be pardoned therefore, if I say a word or two about other gypsum materials that are or should be of considerable interest to the building material dealer. There is gypsum plaster board, the use of which is growing tremendously as its usefulness is recognized and I question very much whether there is any dealer within hearing of my voice who does not at this present time find it to his advantage to sell plaster board.

In addition to the advantages there is from a business point of view in selling plaster boards, you are undoubtedly interested in the fact that plaster boards have a very real value in preventing the spread of fire. Many cases might be cited of fires that have occurred where the damage has been kept to a minimum because boards have been used as a lathing material. In selling plaster boards therefore, you are helping the cause of fire prevention.

In recent years a very large growth has occurred in the use of gypsum plaster blocks, principally for the construction of partitions in the so-called "fireproof" type of buildings. Many tests have been conducted by the Underwriters' Laboratories and other institutions, which have demonstrated that gypsum block partitions have a very high efficiency in fire resistance and so its growth has been rapid until to-day in the country at large probably sixty times as much gypsum plaster blocks are used as were used only eight years ago.

This growing appreciation of the value of gypsum plaster blocks is leading to recognition for the protection of important vertical openings in buildings, such as elevator shafts and for steel protection and more recently, as book tile for roofs, placed between the steel frames or steel perlins of steel roofs. A very considerable area of structural floors are now being used made of gypsum in poured form reinforced by steel. In this connection, it will be interesting to you if I refer to what happened in Paris, France, during the days of the Commune immediately following the Franco-Prussian War. As you know, efforts were made to burn Paris, but these efforts were futile and it is a coincidence, if it can not be proved to be directly the reason for this failure to burn up Paris, that ninety-five per cent. of the floors of buildings in Paris were and are to-day, constructed of poured plaster of Paris; in other words, reinforced gypsum.

The Improved Highway as a Tactical Unit in National Defence

By P. S. Bond, M.A.S.C.E.*

The usefulness in war of a substantial system of highways can scarcely be overstated, but it can be misunderstood and frequently is. Our freedom from wars, during long periods, has made the term "military road" little more than an historical phrase in America. It calls to mind the Cumberland pike and suggests the conditions of military enterprise that gave rise to our constitutional provision for federal military roads.

Those conditions antedate the railroad. In the present state of affairs the longer hauls for the assembling of soldiers, munitions and supplies will almost invariably be made by rail. Military considerations do not call for long single lines of road through the interior of the nation so much as for intensive systems of parallel and intersecting roads in the probable zones of actual warfare in case of attack by a foreign enemy.

Military Roads

To appreciate the tremendous usefulness of such road systems, it may be necessary to review some of the conditions of modern war as exemplified in Europe to-day. In speaking of innovations, I use the word with respect to popular United States conceptions of war, which are still largely founded on the civil war of the sixties. The European war has really developed very few innovations, from the standpoint of the military student. Attacks by gas and liquid fire, effective as surprises, have been among these few. The general nature of the struggle was either anticipated by military men or actually demonstrated in the other wars of the last two decades. I wish particularly to refer to some phases of modern war with reference to the use of highways.

While less reliance than formerly is placed upon permanent fortifications, trench warfare between nearly equal forces tends to develop a condition of deadlock, in which the tactics are similar to those of a siege. Hence, the routes of supply do not, under certain conditions, vary as much as in the old days of open fighting when one army would pursue another half across a continent on foot.

Nature of Military Traffic

Not only are routes of distribution more nearly permanent, but the volume and weight of the traffic is such as to justify and require the most substantial kind of highways. Larger armies eat more food. Larger and more intricate guns consume immensely more ammunition. The British army in Belgium is said to have fired more shells in a single day than were used in the entire Boer war. These are transported from the railroad terminals to the place of consumption very largely by motor truck and the effect on any but the most substantial roads can be imagined.

Add to these conditions the mobility now required for very heavy guns. It can be seen that the placing and replacing of ordinance weighing many tons per piece—the saving of guns in case of a sudden retreat—would be virtually impossible under the conditions that prevail on most United States highways during long seasons, or would impose the heaviest possible tasks upon the engineering arm of the service.

We have pictures showing the kind of improvised roads upon which the Germans have been compelled to rely in Russia. They follow the principles of the old American corduroy road, with a foundation of stringers and transverse logs, on which are laid brush and dirt. The contrasting advantages of level, durable road surfaces, prepared in time of peace with an eye to the exigencies of war, are so striking as to make comment unnecessary.

Motor Truck in Tactics

But the greatest advantage of motor trucks and suitable motor roads has yet to be mentioned. To appreciate it, one must bear in mind the broad nature of battle tactics. War is not unlike football. An army must hold the foe in check at all points on the line and rely for its success upon smashing attacks by the concentration of troops at some particular point. In the old days the plan of attack was often concealed from the enemy until the moment when it was sprung. Distance and natural obstacles to vision made it possible to work out a manoeuvre with comparative leisure. To-day the hostile aeroplane hovers overhead and conveys prompt information of the concentration of any considerable body of troops at any given quarter.

To render such an attack effective, it is therefore necessary to make it a sudden attack, like the dash of the backfield in a football game. To be able to move a whole division by truck and auto to a critical point at a rate of twenty or thirty miles an hour would greatly facilitate both offence and defense. It is said that the battle of the Marne was won by the sudden concentration of French troops, using motor transport over the splendid chaussees of France, upon the German left wing.

System of Roads

One road will not suffice for this variety of tactics, although one is better than none. The ideal would be a number of parallel routes traversing the line of battle, with frequent cross roads to permit the distribution of reinforcements at any desired point or points. In war there is only one rule for success, and that is to oppose a lesser force with a greater force at the crucial point in the conflict. This does not mean that the largest army always wins, for the largest army may have three-quarters of its numbers out of action through lack of generalship or failure of transport facilities. Mobility can take the place of numbers much better than numbers can be made to take the place of mobility. When this fact is digested, the

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immense tactical value of paving can be better appreciated.

The motor can thus lessen the fatigue of forced marches and increase their possible radius five fold or more. It is also probable that motors will take over part of the work of transport formerly accomplished by rail. There is considerable necessary delay in entraining troops and getting a clear track for their movement, so much so that the old rule was to undertake movements of thirty miles or less on foot, as being prompter than train service. With suitable roads and an abundance of motor vehicles, this line of demarcation might be placed at sixty or a hundred miles or more, depending on the particular circumstance of the case.

Efficiency of Brick Pavements

The unimproved highway is our weakest link today from the standpoint of military transport. America has the railroads. It has the autos and auto trucks. Whether the latter can be used, or whether we must go back to the age of the mule whacker and the dreary march rests with those who are responsible for our highway improvements. Any city within a hundred miles of our coast or frontier may some day be the base of military operations that will put its surrounding highways to the severest test. Very few would meet it creditably. Cuyahoga County, surrounding Cleveland, would offer a better opportunity for modern manoeuvres than any similar locality with which I am familiar. The brick road, properly constructed, stands high in the estimation of army men for such purposes as I have been describing.

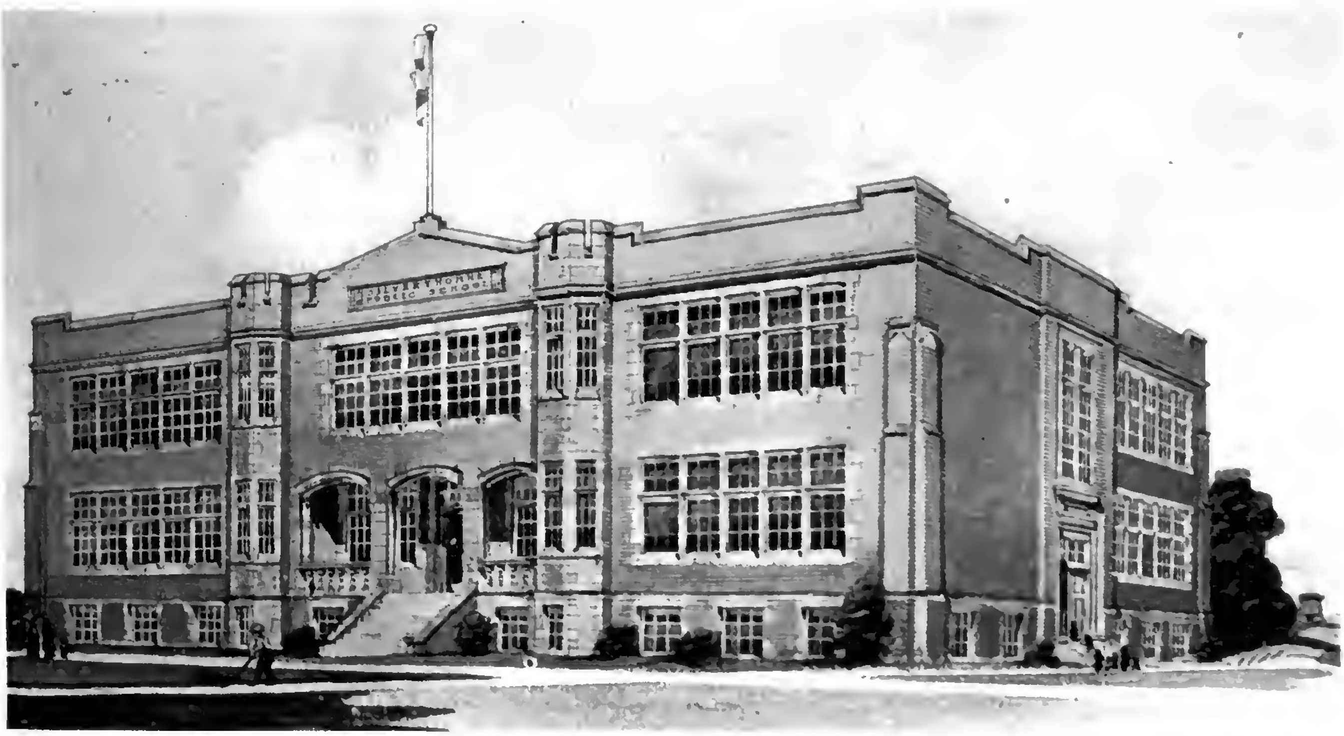
In a military crisis such a system of roads would much more than pay for itself in the saving of other forms of military expenditure. Considering also how they conduce to the wealth of the nation in times of peace, there seems to be no possible argument against this phase of preparedness.

Silverthorne Public School, Mount Dennis Ont., Under Construction

Contracts have been awarded for a new public school for School Section No. 28, Mount Dennis, Ont., and work has been actively commenced.

The new school is to be semi-fireproof in construction, to be built of common stock red brick, with stone trimmings and copings; foundations and footings are concrete. The building will be two storeys and basement high, to have five standard classrooms, kindergarten, a principal's and teachers' room. The basement has provision for large playrooms for boys and girls, the usual room for fuel and heating equipment, and lavatories. The classrooms will have mullioned, leaded glass windows, hardwood floors, slate blackboards, and are all provided with a separate cloakroom. The corridors on the first and second floors run the width of the building, and will have terrazzo floors. The basement floors are concrete. The stairs will be steel with mastic treads. The system of heating and ventilation is to be by forced steam with electric fan ventilation. A more complete description of the school will be furnished on completion.

The school was designed by S. B. Coon & Son, architects, Toronto, and the following contracts have been awarded: masonry, Albert Webb; carpentry, Hudson & Mosely; heating, plumbing, and ventilation, George Sainsbury; steel, McGregor & McIntyre; steel sash, Henry Hope & Sons; plaster, George White; painting, Fells Bros.; electric wiring, Moon & Company; terrazzo floors, Italian Mosaic and Marble Company.



Silverthorne Public School, Mount Dennis now under course of erection.

Canadian Railway Statistics, 1915

Dominion Roads Show Creditable Record Despite Adverse Conditions—Gross Earnings, $199,843,072.13

Returns of the railway statistics of the Dominion of Canada for the year ending June 30, 1915, are to some extent rather remarkable for the first year of the war. Receipts show a decrease, but the operating expenses show a decrease also, while the total mileage shows an increase.

Though the railways were hit hard by the war, due to the scarcity of freight for transportation and the decreased tourist trade, but more particularly by the poor western crop of 1914, they showed a remarkable adaptability in adjusting themselves to the adverse existing conditions. With the record crop of 1915 to handle, the increasing activity in industrial life, especially in munition work and trades pertaining thereto, we may safely say that the lowest point has been reached and passed, and that returns for the present year will show a big increase in receipts and gross earnings.

There was an unprecedented increment in the mileage operated, reports showing an increase of 4,789.9 miles, as compared with 1,491.01 miles increase in 1914. This addition brought the total mileage in Canada up to 35,582.44—a mileage which places Canada in the first place among the nations on the basis of railway mileage per capita, and fourth among the nations in regard to the total mileage, being exceeded only by the United States, Russia and Germany. There was also 1,593.4 miles of line reported as still under construction. Ontario led in the increase in mileage with 1,447.53 miles, with Alberta a close second with 1,122 miles.

The capitalization of railways officially classified as being in operation stood at $1,875,810,888 on June 30, as against $1,808,820,761 in 1914—an increment for the year of $66,990,127. There was an increase for 1915 of $2,977,412 in consolidated debenture stock, an increase of $69,322,267 in funded debt, and a decrease of $5,300,552 in stocks. The falling off in stocks was due to an adjustment of capitalization by the Canadian Northern and its subsidiary corporations. The total amount of cash aid given during the year was $5,059,-284.17. This contribution was made up as follows:—by the Dominion, $4,644,664.17; by the provinces, $414,620. Land grants by the Dominion Government and the province amounted to 43,929,312 acres.

Traffic

The public service of Canadian railways in 1915 was represented in the carrying of 46,322,035 passengers and 87,204,838 tons of freight. As compared with 1914 there was a decrease of 380,245 in the number of passengers carried, and a decrease of 14,189,151 tons in the movement of freight. It should be understood in connection with the number of passengers carried, that in 1915, for the first time, the report of the Canadian Northern Railway system includes traffic attaching to the Niagara, St. Catharines and Toronto Railway heretofore classified with electric railways. The number of passengers carried by this electric line was 4,771,004. Earnings from passenger train service—including ticket sales, mails, express, baggage, etc., were $65,354,768.16, as compared with $72,564,203.20 in 1914. The record of passenger service for the year shows quite clearly that fewer people travelled by rail, and that the average journey was considerably reduced. These basic facts are reflected in lowered earnings and a smaller average number of passengers per train and per car.

Of freight, 87,204,838 tons were carried in 1915, which showed a decrease of 4,189,151 tons as compared with 1914.

Gross Earnings

Gross earnings for 1915 amounted to $199,843,-072.13, or $43,240,456.91 less than for 1914. This decrease was equal to 17.8 per cent. Operating expenses aggregated $147,731,099.47, which involved a decrease of $31,244,159.43, or 17.5 per cent. as compared with the preceding year. The ratio of operating expenses to gross earnings was 73.94, as against 73.63 in 1914. These figures show how flexible the railways were in adapting themselves to meet the adversity of the decreased traffic, the percentage of operating expenses to earnings increasing only a fraction of one per cent.

The difference between gross earnings and operating expenses, popularly regarded as net earnings, was $52,111,972.66, as compared with $64,108,280.14 in 1914. Gross earnings from the outside operations of Canadian railways were $20,332,305.65, as against $23,882,141.90 in 1914. Combining ordinary earnings and outside earnings, a total gross corporate revenue of $220,175,-377.78 is established for the year. After deducting operating expenses, the net earnings from outside operations in 1915 were $6,273,794.26, as compared with $4,097,338.28 for the previous year. The aggregate of net earnings from these two sources, as represented by the difference between gross receipts and operating expenses, was $58,385,766.92. To the foregoing should be added the income of railways from other sources than ordinary and outside operations, amounting to $14,111,482.85. With this addition the final net revenue would be $72,497,249.77. This total in 1914 was $82,134,693. The total revenue from passenger train service for 1915 was $60,699,934.82, made up as follows: passengers, $50,173,267.29; mail, $3,026,773.41; express, $6,059,384.72; other sources, $1,440,509.40.

The railways were perhaps the first industry to feel the shock of the war, and within the year the number of employees was reduced from 159,142 to 124,142. Yet, with this large decrease in men, the high standard formerly maintained on road-bed and equipment was not sacrificed. With the decreasing traffic the rolling stock was correspondingly decreased, the old deteriorated equipment being taken off, leaving only the better equipment. Fuel consumption was also very materially decreased, from 8,547,675 tons in 1914 to 6,903,418 tons in 1915; and with a lower cost per ton of $3.02 as compared with $3.12 the previous year, expenses were thus materially reduced. A striking feature of the fuel consumption was the increased use of oil by locomotives.

A large factor in the increased cost of maintenance has been the rising price of ties, and the increasing use of treated ties is the natural result of the excessive cost of untreated wood.

The number of accidents from train movement was ever so much less than in the previous year—360 killed in 1915, against 565 in 1914, and 1,578 injured in 1915 compared with 2,287 in 1914.

Electric Railways

Electric railways seem to follow pretty closely the steam roads; again the reports show an increase in the growth of the industry but a decrease in the revenue. During the year 50.51 miles were added to the mileage, bringing it up to 2,102.95. Capitalization increased from $147,585,342 in 1914 to $150,344,002 in 1915. Gross earnings amounted to $26,922,899.70, as compared with $29,691,077.21 for 1914. Operating expenses had a total of $18,131,842.18, as against $19,107,817.60 for the year preceding.

Reviving Activity

The crisis seems to be past; yet we cannot hope for some time to attain again the high-water mark of 1913. Especially in railway construction. According to the reports, there is only about 1,600 miles contracted for for the coming year. Railways are built on borrowed capital, and with the stringent state of the money market capital is at too high a premium to make financing an easy matter. Yet trade in general has responded to the confidence of the people, already the railways are beginning to make up the deficit, and the railways are a good barometer.

Canada is in a grand position to stand the strain of the war, and well adapted to take advantage of commercial opportunities when it is successfully terminated. For years immigration has aided both the railways and the country, and with the termination of the European struggle Canada should again experience a marked increase in immigration. Whether we build more railways or not in the near future, we are supplied in the meantime with sufficient mileage to develop the resources of the country—which should be our chief consideration.

Recommended Practice in Concrete Road Construction Adopted at Chicago

THE report of the Committee on Resolutions to the Second National Conference on Concrete Road Building, held at Chicago, February 18, contained a number of interesting conclusions. In an outline of the conclusions of the conference, the report gives a list of 12 salient features of practice. These are: (1) Drainage of the roadbed is vital; (2) subgrade must be of uniform density and should be compacted; (3) aggregates must be clean, hard and tough; (4) fine aggregates (sand) should be coarse and well graded; (5) a rich mixture must be used; (6) materials must be accurately proportioned; (7) mixing must be most thorough; (8) sloppy concrete must not be used; (9) in general, the use of reinforcement is justifiable; (10) inspection must be intelligent and thorough; (11) concrete must be protected from rapid drying; (12) pavements must not be opened to traffic too soon.

The following principles were adopted as representing good practice in the construction of concrete roads and pavements:

Materials.—Portland cement shall meet the requirements of the standard specifications of the American Society for Testing Materials, and tests should be made in accordance with the methods outlined by the American Society of Civil Engineers.

Aggregates.—Samples of materials should be submitted to the engineer for approval before orders are placed, and, if possible, laboratory tests should be made. If this is impracticable, field tests should be made. The different aggregates should be kept clean and separate. Aggregates to be used in the wearing course of two-course pavements should be placed on planks or some other means provided to keep them free from dirt.

Water.—A large supply of water is necessary for (a) sprinkling the subgrade; (b) mixing the concrete, and (c) keeping the concrete moist during early stages of hardening. For this latter purpose 25 to 30 gallons per square yard of pavement will be required during the summer months. Insufficient sprinkling is detrimental to the wearing qualities of the pavement.

Reinforcement.—The use of reinforcement is increasing. A coating of light rust will not be detrimental, but excessive rust, paint or other coatings interfere with proper bond. Reinforcement should be kept free from dirt and should be subjected to occasional tensile and bending tests.

Joint Filler.—Joint filler should preferably be of single thickness. Transverse joint filler should be cut to the crown of the pavement by the manufacturer when metal plates are used. A type of joint filler which will iron out readily under traffic is preferable for use in unprotected joints. A joint filler which will not bend easily when concrete is deposited against it is to be preferred.

Joint Protection Plates.—Metal joint protection plates should be properly bundled and wired by the manufacturer. Plates up to 20 feet should be shipped in single lengths. The exact length should be provided so that the contractor would not have to cut plates. In cutting plates for length, spacing between eccentrics on the installation bar should be considered to avoid interference with anchorage lugs on plates. The manufacturer should use particular care in crowning the bar to avoid the necessity for duplication of work by the contractor.

Drainage.—For roads, proper drainage may be secured through lateral ditches. For streets, as well as roads, tile drains may be used. They should be laid on each side of the roadway or on one side only, with cross drains leading thereto. Drainage trenches, if placed under the subgrade, should be completed before the final rolling.

Grading.—In general, fills should be made in thin layers, the depth depending upon the character of the material used. The fill should be allowed to stand for as long a time as possible, giving it an opportunity to settle before the pavement is placed on it. Deep fills should be allowed to settle through one winter whenever possible. Puddling will be found advantageous in compacting deep fills. Wetting and rolling should be performed when making a fill, in order to secure thorough compaction. Fills should never be made with frozen materials nor with lumps greater than 6 inches in their greatest dimension.

Subgrade.—The fundamental requirement of the subgrade is that it should be of uniform density so that it will not settle unevenly and cause cracks in the surface of the pavement. When the pavement is constructed on virgin soil, care should be taken to remove all soft spots. If laid on an old roadbed, even more care should be taken, as the subgrade is likely to be more compact in the centre than at the sides. An old roadbed should be scarified, re-shaped and rolled. The subgrade adjacent to curbs should be hand-tamped.

Forms.—Metal forms are preferred. When wooden forms are used they should of be at least 2-in. stock, capped with 2-in. angle iron, so constructed that sections can be lapped. Particular care should be taken to see that top edges of forms are clean, so as to avoid unevenness in the finished pavement.

Pavement Section: Thickness.—In view of the increasing use of the heavy motor truck and bus, it seems unwise to build pavements less than 6 inches thick at any point. In general, pavements should be thicker at the centre than at the sides. Alleys with an inverted crown and narrow, one-slope roads should have a uniform thickness. Wherever increased thickness can be secured without excessive cost to secure a flat or nearly flat subgrade, such increase is advisable.

Width.—The desirable width for a single-track road is 10 feet; for double-track road, 18 feet. The total width should be not less than 20 feet for single and 26 feet for double-track roads.

Crown.—The crown of roads and pavements should not be less than 1/100th nor more than 1/50th of the total width. Except in unusual cases, 1/100th is sufficient for country roads and 1/50th will be considered satisfactory for alley pavements. For city streets an average crown of 1/75th will generally be found sufficient and should not be reduced except on grades.

Joints.—Transverse joints should be placed across the pavement perpendicular to the centre line, about 50 feet apart. There seems to be a tendency to widen the distance between joints. Joints should extend entirely through the pavement as well as through the curb if integral curbs are used.

Longitudinal joint filler should be staked or otherwise securely held against the curb. Joint material should be placed around manholes, catch basins, etc.

The tendency of present practice is toward the omission of metal protection plates for joints. Plates are more essential in street pavements than in country highways. Plates for protected joints should be wired together with the joint filler and securely held in the installing bars, even when short sections of filler are used. Supports should be used when the pavement is of such width that the installing bar deflects. On wide streets every joint should be checked as to crown with sighting T's. When necessary to have plates in two sections, the contractor should arrange to have the manufacturer drill the abutting ends so that the plates may be wired or strapped together. As the plates do not fit tight to the installing bar, a ¼-in. shim is placed under each end of the installing bar to insure that the plates are not covered with concrete.

Mixing and Placing Concrete: Measuring.—It is recommended that a sack of Portland cement, containing 94 lbs. net, be considered the equivalent of 1 cubic foot. The method of measuring materials, including water, should insure accurate proportions at all times.

Proportioning.—The proportions should not exceed five parts of coarse aggregate, measured separately, to one part of Portland cement. The fine aggregate should not exceed 40 per cent. of the mixture of fine and coarse aggregates.

Aggregates.—Bank-run material shall not be used. Proportioning based on sieve analysis or by relative density tests is not practical for concrete roads except where laboratory direction is available. Where proper facilities are available, the above proportions should be varied as the tests warrant.

Mixing.—The ingredients should be mixed in a batch mixer of approved style and the size of the batch should not exceed the rated capacity of the mixer. The mixing should be continued for at least one minute after all the materials are in the mixer and before any of the concrete is discharged. The speed of the mixer should not be less than ten revolutions per minute. The time and not the number of revolutions should be the gauge of proper mixing.

Consistency.—The practice is to mix entirely too wet. The consistency should be such as not to require tamping, but not so wet as to cause the separation of the mortar from the aggregate in handling and placing.

Placing.—If the subgrade has been disturbed by teaming or other causes, it should be brought to its former surface and thoroughly saturated with water. The concrete should be deposited rapidly to the required width and depth. The section should be completed to a transverse joint without the use of intermediate forms or bulkheads, or a transverse joint may be placed at the point of stopping. If the mixer breaks down, the concrete should be mixed by hand to complete the section. Where reinforcement is used, it should be embedded in the concrete before it has begun to set. The concrete above the reinforcement should be placed within 20 minutes after placing the concrete below. In two-course pavements, the top should be placed within 20 minutes after placing the bottom.

Finishing.—The surface should be struck off by means of a template moved with a combined longitudinal and transverse motion. The excess material accumulated in front of the template should be uniformly distributed over the surface of the pavement, except near the transverse joint, where the excess material should be removed. The concrete adjoining the transverse joint should be dense and any depressions in the surface should be filled with concrete of the same composition as the body of the work. After being brought to the established grade with the template, the concrete should be finished from a suitable bridge, with a wood float to true surface. A metal float should not be used. Brooming of the surface is not necessary and grooves are objectionable, even on grades.

Retempering.—Retempering of mortar or concrete that has partially hardened, that is, mixing with additional materials or water, is strongly condemned.

Protection and Curbing.—Too rapid drying out, early exposure to low temperature or opening to traffic at too early a period may seriously damage the best concrete. Hot sun and drying winds are most liable to dry out concrete too rapidly, causing shrinkage cracks or a surface which will not wear well under traffic. The use of a canvas covering will be found effective in preventing this. Sprinkling should not be omitted during the day in case the surface shows a tendency to dry out. Where there is danger of freezing, sprinkling should be omitted and a covering of canvas or straw and canvas should be used. Placing concrete roads in temperatures at or near the freezing point is not advisable. Where such practice is unavoidable the water and aggregates should be heated and fresh work protected from freezing for at least ten days. Chemicals should not be used to lower the freezing point of the mixture. Concrete should not be deposited on a frozen subgrade.

Opening to Traffic.—Under most favorable conditions a concrete pavement should not be opened to traffic in less than two weeks. When conditions warrant, the interval should be at least four weeks.

One-Course Pavement.—Where the materials most readily available are such as to give good construction in one-course pavement, such construction is recommended.

Integral Curb.—The integral curb is recommended in preference to straight curb or combined curb and gutter. Precaution should be taken that the curb is thoroughly bonded to the pavement proper.

Specifications.—The standard specifications for pavements and roadways of the American Concrete Institute are recommended.

Building Construction and a Few Common Causes of Failures

Failures, whether in the building trade or in any branch of engineering, always furnish a peculiarly interesting subject for investigation; because from the failures and errors of the past present builders may gain experience and incorporate new ideas, which should result in a better class of buildings. "Dangerous Structures" was the subject of a practical paper along this line, recently read by W. G. Perkins, district surveyor, before the Concrete Institute, London. The following extracts from Mr. Perkins' paper in The Surveyor are interesting.

Causes of Failures

Amongst the causes of a dangerous structure are the following:—(a) faulty construction; (b) faulty materials; (c) faulty design; (d) decay and fatigue; (e) overloading; (f) removal of extraneous support; (g) wind pressure, shock, etc.; (h) fire and explosion, bombs.

I propose to enumerate a number of cases where failures have resulted from one or more of these causes; particularly (a), (b) and (c).

Perhaps few of us have had any experience with failures arising from faulty design and materials in modern structures, as a sufficient period has not elapsed for time to have done its work, but there are numerous instances in buildings erected by former generations.

We moderns are often called to account for the supposed inferior manner in which we build, being told that our buildings are not solid like those erected in "the good old times," that we have lost the art of making good mortar, etc. People who make such remarks have, I fear, only an acquaintance with the jerry-builder of the very bad type. The majority of buildings erected in London 100 to 200 years ago were constructed in a most inferior manner. The mortar appears to have been compounded with a fat lime, dry slaked, and, judging from the nodules of loam it contains, mixed with a good deal of the "top spit" of the field. Naturally such stuff has, and had, no binding qualities, and to this day is only so much dusty rubbish.

The bricks were badly shaped and easily broken, so much so that in taking down old walls one finds course after course of what appeared to be headers to be only "bats."

In many old buildings the main beams of the floors are placed diagonally and the loads from the roof and four storeys are imposed upon a pier of brickwork about 14 inches square. Needless to say, such piers have crushed.

Strangely enough, this kind of brickwork is always stronger in damp positions, the moisture having enabled the lime to a certain extent to set. Workmen refer to this state as being "water bound."

Again, I have found a wall of this period built with two skins of brickwork, 4½ ins. thick, "tied" together with wooden laths at intervals of about 18 inches in height, the space between being filled with small pieces of brick and stone.

A form of construction frequently found is a shell of 4½-in. brickwork around a stout timber post. You see the brickwork bulging and wonder why a stout-looking pier, perhaps 2½ bricks square and 8 feet in height, should be failing under a comparatively light load. The explanation is that the timber post has decayed at its lowest end and the thin shell of brickwork is unable to carry the superstructure.

Modern Brickwork

Modern brickwork is not without its faults, due principally to the lax manner in which it is supervised and an imperfect knowledge on the part of the specification writer. He will, for instance, require that four courses shall not exceed 12 inches in height, and then select bricks that are very little less than 3 inches in thickness. The consequence is that the bricklayer, to keep to the specification, will put an insufficient bed of mortar in laying the bricks. I have had as much as 3 feet of glazed brickwork at a time taken down because there was absolutely no mortar in any of the beds. And this was on a first-class job, under architects and a clerk of works. Again, when the bricks have a frog, that frog should be upwards when the brick is laid, otherwise the brick beds only on the rim and its bearing area is reduced by one-third. When the bricks have two frogs, one should be "buttered," or filled in before laying.

Unless strictly supervised, the vertical joints are never filled solid. Some mortar is rubbed over the top of the course with the flat of the trowel, which may enter the joints some three-quarters of an inch.

A habit of the bricklayer, after having spread the bed is to work the mortar away from the centre with the point of the trowel. The mortar does not squeeze along and make a solid bed as some people argue. To ensure solid work the beds should be thickly spread and the bricks pressed down into it, frogs up, and the whole course grouted up by heaping mortar on the wall and softening it with water from a "gauge pot" so that it becomes soft enough to flow into the vertical joints until they are full.

Unless the beds and joints are full you cannot expect to get the full value out of your walls and piers, which, by the way, are always eccentrically loaded. The evil is aggravated when the wall is faced with stone, for the mason generally spreads a bed of putty, 3 or 4 inches wide, along the outer edges of the stone he is laying (which may be 14 or 18 inches on bed), points up the back edge, and after having poured some grout down the vertical joints, considers he has made a solid job! Have the stone taken up again and note the result.

Workmanship of this sort leads to "flushing" and the fall of pieces of stone. The bed of every course of masonry should be screeded.

Many people object to slate damp-proof courses, as they become inefficient owing to the slate cracking. They only crack or crush when they have been imperfectly bedded. The usual way is to lay them on a bed of cement(perhaps containing a number of small stones) and tap them down with the trowel. This always results in the centre of the slate being unbedded. Walk along such a damp course on your heels, and you will demonstrate to the builder in a striking manner the hollowness of his work.

Use cement made with a sand that contains no small stones, rub each slate well into its bed, and you will get a damp-proof—not a damp—course.

I am not partial to asphalt damp-proof courses unless they are of genuine asphalt. Artificial asphalts are brittle when cold, but become soft in the heat of summer or near a heating chamber, and squeeze out. This allows settlement, and in the case of a retaining or other wall with a lateral thrust to sustain, may allow sliding on the bed, a result which happened not very long ago "somewhere in the Midlands."

Dangerous Concrete

Failures have occurred by using unsuitable materials in the composition of concrete.

There was the case of the reservoir where blast furnace slag was used as the aggregate for its concrete walls. The water affected the concrete so that it became quite soft and rotten, and the walls had to be rebuilt.

Concrete made with breeze is a dangerous material. It is one of the materials specified in the London Building Acts as a fire-resisting material, and as a district surveyor I have, much against my better knowledge, to pass it. This stuff was used for the floors of sculleries in the first storeys of a row of houses built under my official supervision. In every house this stuff expanded, pushing out the walls, some of which had to be rebuilt.

In another district I had to inspect a block of residential flats, the walls of which were bulged at every floor level, owing to the expansion of the breeze concrete.

Loading of Bressummers

It is convenient at this point to refer to the loading of bressummers. Text-books state that when an imperforate wall is built upon a beam the load on that beam may, owing to the bond of the brickwork, be assumed as the weight of the brickwork enclosed by an equilateral triangle which has the clear span for its base.

It is dangerous to make this assumption, for it cannot hold good unless the bond is practically perfect, and all the vertical joints filled solid with cement. Unless you watch every brick, the work is not done in this manner, but as I have already described.

And I would ask, if by the bond all the load of brickwork above the equilateral triangle can be transferred direct to the supports, why should not any portion of the load near the supports or any concentrated load actually over the supports be distributed over and towards the centre of the span?

The method of building a wall brick by brick with soft mortar ensures, I think, that the whole of the masonry over the spans is borne by the beam, and this view is borne out by a case with which I have recently dealt.

Wooden storey posts supporting bressummers decay at the ground line, and are a fruitful source of dangerous structures, as a rule easily dealt with.

You are all familiar with the small suburban house of two or three storeys in which one-half of the weight of the roof and floors is imposed upon a central partition of slender timbers lathed and plastered. The timbers of this partition in the lowest storey are sometimes found to be in a state of decay owing to the want of a damp-proof course. Rotting at the feet, they allow the floors and roof to sag towards the centre of the building and tend to push out the walls.

By-laws which permit the most heavily loaded portion of the building to be constructed with 2 x 4 in. or 2 x 3 in. battens are seriously defective.

Ends of beams and roof trusses solidly built into walls sooner or later decay, and cause dangerous floors and roofs. Ventilation is a sine qua non wherever timber is used. A roof boarded, felted, and covered with slate or metal and ceiled will develop dry rot.

Foundations

The term "foundation" is sometimes used in a very indefinite manner, and may mean the actual base upon which the superstructure is reared or the soil itself.

It has been suggested that the proper meaning of the word is the artificial arrangement or construction prepared or made to support the base of a superstructure; whilst the soil beneath should be termed the foundation bed.

Foundations are important, as when defective or insufficient they will lead sooner or later to a dangerous structure.

In dealing with structures rendered dangerous by settlement owing to the insufficient bearing capacity of the soil, I prefer, wherever there is an underlying stratum of firm material, to sink down to it, even though it should be at a considerable depth. The sinking should be in the form of pits (the area of which would be determined by the loading and the bearing capacity of the firm material), filled up with good mass concrete. Then from pier to pier either construct beams of reinforced concrete or fix rolled steel joists encased in a rich and well-graded concrete or turn arches.

I am not an advocate of raft foundations, for unless your structure can be symmetrically disposed about the raft or its centre of gravity be made to coincide therewith—a very difficult thing to do except in a symmetrical building—the pressure on the soil will be unequal, the raft will tilt and throw your structure out of the perpendicular. The same thing will happen if the soft soil is not of even consistency and bearing value all over.

Trenches

Digging trenches for drains and sewers without sufficient timbering has been a fruitful source of dangerous structures.

(Continued on page 412)

Vertical and Horizontal Reinforcing of Concrete Columns

Considerable has been written from a technical point of view on the strength of reinforced concrete members, as governed by the systematic placing of the reinforcing bars in such positions as to give the maximum strength to the members. Mr. A. M. Wolf, C.E., writing in the Cement World, gives a few notes on placing reinforcing in concrete columns, from a practical point of view.

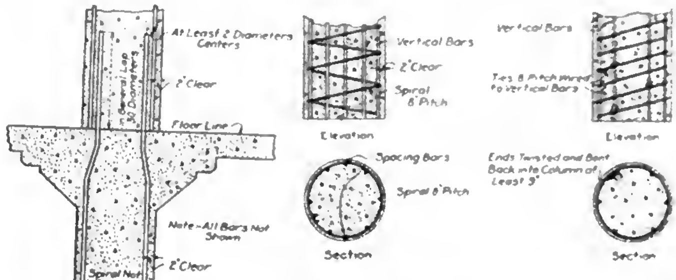
A plain concrete column should not be allowed in any first class building; this does not mean that it should not be used in piers, but for slender columns, those less than 18 inches in least dimension, never. The chances taken with such construction are out of all proportions to the additional cost of a few reinforcing bars, which will at least give the column a factor of safety of more than 1. Experience on actual construction shows that the same care is not exercised in pouring plain concrete as is in the placing of reinforced concrete; and for this reason, if no other, some reinforcement should be used in a bearing member. Even if a column with a ratio of length to least dimension of six with a unit stress of only 200 pounds per square inch is used, it is in the writer's opinion, money well spent to provide longitudinal reinforcement stayed at intervals of not greater than 6 to 12 inches, depending on the size of column or size of bars. In other words, plain concrete columns should be absolutely forbidden, since they have no place in building work. When they are, we will have fewer failures to record.

As for considering eccentric load on plain concrete columns, the writer considers this procedure as flirting with danger. It is perfectly logical and correct to consider this in the development of a discussion on columns, but in the writer's opinion all such discussion should be plainly labeled as theoretical and not practical, since the man who had little experience is not in a position to distinguish the practical limits of theory.

In connection with the design and construction of what are commonly known as longitudinally rodded columns, the writer has found that where such columns are used, that is for carrying light loads as in the upper stories of buildings, and in which the unit stresses are low, i.e., below 500 pounds per square inch on net section, a continuous spiral at a wide pitch is better than a number of loose ties. Such a spiral at 6 to 8-inch pitch by virtue of being continuous, is unquestionably better fitted to stay the longitudinal bars than a number of disconnected, loosely fastened hoops and at the same time requires only a trifle more steel. It also eliminates the difficulty experienced in holding longitudinal bars and the hoops themselves in place. By using two light spaces on such a spiral it can be shipped, "knocked-down," and when expanded, and the spacers set opposite one another, a fairly stiff cage is formed to which the vertical bars can be fastened: this insures proper spacing of bars and hooping which the loose hoop tie method does not. The fabrication cost for such spirals is less than that for hoops at about the same spacing, and the cost of placing the reinforcement is also much less than where hoops are used. Since economy can be effected, and the column materially strengthened by the use of spirals at wide pitch in place of hoops, it seems rather unprogressive to continue the use of the latter, except of course in cases where the vertical bars are placed in the form of a square or rectangle instead of in a circle.

Recent experiences in severe fires have shown conclusively that a covering of 2 inches outside of reinforcing bars cannot be relied upon to stay the latter under such conditions, and engineers are now practically agreed that a rodded column without ties is not good practice. A study of the various reports on the Edison fire will reveal the truth of, and the basis for this statement.

A few words regarding the splicing of column bars at floor levels will probably not be amiss. As for wiring or clamping bar together, to transfer the stress from one to the other in lieu of the longer lap of bars wherein the transference of load is obtained by bond between concrete and steel, it has been shown by tests that such methods of splicing will not develop the proper strength. With both wired and clamped splices where the length of bar lap is cut down to make allowance for the "supposed" efficiency of the splices, it has been found that they cannot be made tight enough to act before considerable slip of bars,



Diagrams show methods of Vertical Reinforcing and Lapping Column Bars at Floor Lines

sufficient to rupture the concrete, has taken place when stress is applied. To the present time no more efficient splice has been found than the simple method of lapping bars a certain number of diameters dependent upon the stresses in same. Such a splice depends on bond between concrete and steel for its strength and it is highly important therefore that the bars are entirely surrounded by concrete, not less than 2 diameters of bar center to center of bars. This means that where columns of the same size and also of different sizes are spliced, the bars from the lower story column should be bent in on easy bends to form a circle well inside the circle formed by the bars above, rather than to have them close together, for where they touch, no bond value can be developed.

Splicing bars by means of pipe sleeves is not done very often at present. Such splices do not tie the different stories of a building together as well as lap splices, nor are the bending stresses likely to be developed in the columns so well provided for, with the use of pipe-sleeve splices. If the sizes of column bars are limited to 1⅛-inch to 1¼-inch bars as a maximum size, splices can be developed without difficulty by bond between lapped ends of bars.

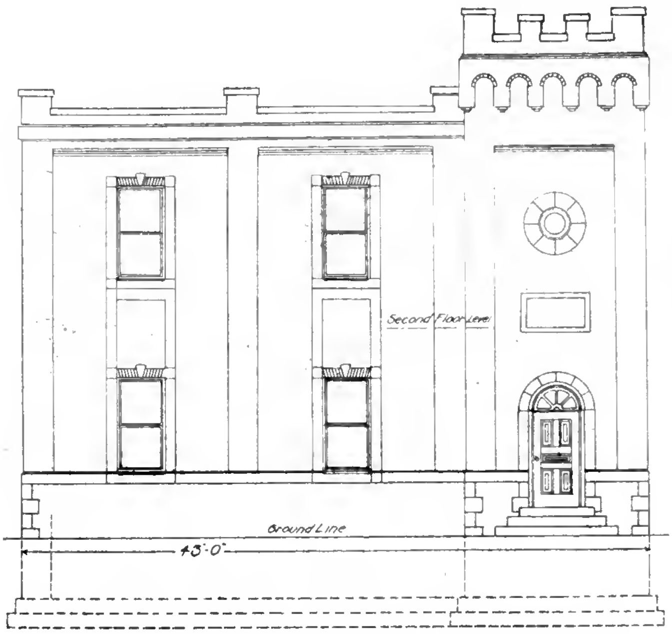
In special cases, as at footings, as combination lap and bearing splice between columns can be used to good advantage, the vertical bars resting on a steel or cast iron ring will transmit some of their load direct by bearing of ring on the concrete, and the remainder by bond between concrete and the stub bars.

Municipal Power and Pumping Station, Sault Ste Marie

THE contract for an electrical sub-station to cost between $10,000 and $15,000 has been awarded by the city of Sault Ste. Marie. When the city assumed the municipal control of the water and light distributing systems in 1914, at which date the franchise of the Tacoma Water and Light Company expired, they entered into an agreement with the Algoma Steel Corporation to supply them with power for lighting, and with the city water-works department to operate the pumping system.

Up to the present the pumping and electrical machinery have been operating in their former location in the power house of the Algoma Steel Corporation. The city, however, decided to build a power and pumping station and to move their equipment into it. Accordingly plans were prepared by their engineer for a building on city property on Gore Street.

The site is an irregular one, being much longer on the front elevation than on the rear. The building is



East Elevation of Municipal Power and Pumping Station, Sault Ste Marie.

consequently irregular also. The building is two storeys, of fireproof construction, brick with stone base and trimmings, with concrete floors and roof.

The lower floor will be taken up largely by two sewerage pump wells with space for future extension. Switchboard and electrical equipment will be placed on the second floor at the North end, where there will also be ample room for extension. The larger part of this floor is partitioned off for use as a meter-testing room for testing water and light meters. The switchboard, which was only recently purchased, is very complete and up-to-date; no new equipment will be installed at present.

The contract for the building has been awarded to I. I. Fitzpatrick, Sault Ste. Marie, and was designed by A. E. Pickering, City Engineer.

The Philip Carey Company, Lockland, Cincinnati, are distributing an attractive booklet entitled "Architects' Specifications for Carey Building Materials." The booklet is splendidly illustrated throughout in colors.

Construction Activity in Berlin, Ont.

The following items indicate the work likely to be carried on in Berlin during the present summer:

Queen Street is to be paved with 6,000 sq. yds. of reinforced concrete; Tarvia pavement with concrete base will be laid on Eby Street and a macadam roadway on South Street; a number of macadam roadways are also to be re-surfaced. Ornamental lighting on Queen Street to Schneider's Creek is under way. A large storm-drain is contemplated through part of Berlin and Waterloo. Sewers will be built on Glasgow Street, Prince Arthur Avenue and Dundas Street. A reinforced concrete bridge is to be built on South Street and also one on Courtland Avenue. The new auxiliary sewage disposal works consisting of pumping station and pumping machinery, sedimentation tanks, spraying filters and humus tanks, were partly constructed last fall and will be complete this year, probably about July. George Moogk, of Weston, is the contractor. The Regal Motor Company intend to build a new factory on South Street. The Onward Manufacturing Company have taken out a permit to build a $10,000 factory on Ahrens Street.

Improvement in Montreal

With the advent of open weather, the construction and supply trades of Montreal are improving. As far as can be seen, no very ambitious building schemes are likely to materialise at present, but a large amount of repair work is being carried out. The permits for last month show only a trifling decrease as compared with the corresponding period of 1915, and this is all the more satisfactory in view of the falling off in the first two months of the current year. Reports from the province are to the effect that a considerable amount of building is in progress, and that the farmers are spending freely on repairs and on new construction.

Have Increased Pumping Capacity

The city of Charlottetown, P.E.I., Water Department has just successfully completed the work of installing a new pump and turbine, having a capacity of 2,000,000 gals. daily, as an addition to the water supply service for the city. Work has been done under the specifications and supervision of R. S. & W. S. Lea, hydraulic and sanitary engineers, Montreal. The machinery was supplied by Fraser and Chalmers, Montreal.

Building Construction and a Few Common Causes of Failures

(Continued from page 410)

Extreme care should be taken when working in bad ground, and the scantlings of the timber should err on the large side, as it is difficult to calculate the pressure to which they will be subjected. If the ground contains water, the pressure may be equal to the extent of the weight of the adjoining buildings. The struts which fix the walings, from the very manner in which they are fixed by driving in, are eccentrically loaded by the earth thrust, and, in my opinion, a system of cross-bracing and vertical ties should be provided to the struts in all deep trenches (of course, at intervals sufficient to leave working room), so that the timbering would not fall to pieces should a movement of earth occur.

Montreal's New Street Lighting System

Cast Iron Standards Fed from Cables in Underground Ducts Embedded in Concrete, Replace Poles and Wires in Business Section

An ornamental lighting system,—the cables for which are installed in the municipal conduits,—has lately been put into operation in Montreal. The streets lighted by the new system are St. Catherine Street, between Atwater and Papineau Avenue, a distance of 2¾ miles, Bleury Street and Park Avenue, between Craig Street and Pine Avenue, a distance of one mile. The system is now being extended down town to include Craig, St. James and Notre Dame Streets and Fortification Lane between Victoria Square and St. Lawrence Street, the square being included. The light is furnished by ornamental inverted magnetite 6.6 ampere arc lamps mounted on cast iron standards of special design.

On St. Catherine Street there are 141 of the new lamps, replacing 57 aerial arcs, while on Bleury Street and Park Avenue 41 of the new lamps replace 18 aerial arcs. These 182 lamps are divided into four circuits, so interconnected in pairs that should one circuit be interrupted some of the lamps on the end of the circuit can be thrown on the other circuit by changing the connection of the four point cutouts in these lamps. The down-town system will have 91 new lamps to replace the 43 aerial arcs now in service. These 91 lamps will be divided into two circuits. The lamps are spaced at an average distance of 125 feet on alternate sides of the street, there being one standard at every intersection and two standards at important intersections and transfer points.

The cable carrying the current to the lamps is No. 6, twin-conductor, paper-insulated, lead-covered, 7500 volt cable, and is installed in a special duct of the Municipal Conduit System which loops in and out of each standard. The cutouts are of the absolute type, and were especially designed to meet the requirements of the Light Department, having four accessible terminals. The location of faults in the cable is thus greatly facilitated, as all four conductors can be exposed in every standard. The leads from the cut-outs to the lamps are No. 6, single conductor, varnished cambric insulated and braided cable. The cables and leads were subjected to a factory test of 20,000 volts for 30 minutes and a test of 10,000 volts for 5 minutes after installation.

The cost of the erection now in operation was approximately $42,000—and the cost of the erection now being installed will be approximately $25,000.

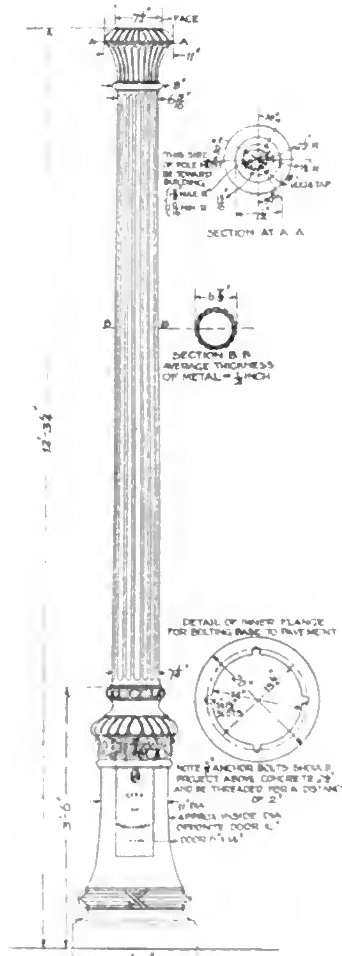
The contracts for the supply and installation of the standards, which included the construction of the concrete bases, were let to G. M. Gest, Limited, of Montreal, Winnipeg and Vancouver, for both sections. The contracts for the supply and installation of the lamps (the glassware for which was manufactured by the Jefferson Glass Company, Limited) were let to the Canadian General Electric Company for both sections, while the order for the supply and installation of the cable and cut-outs was given to the Eugene F. Phillips Electrical Works, Limited, for the system now in operation, and to the Northern Electric Company for the section at present being installed. The cut-outs are manufactured by the Northern Electric Company.

The current for the lamps is supplied by the Montreal Light, Heat & Power Company, under a ten years' contract, at $72.70 per annum per lamp, this price including the supply of station apparatus and the general care and maintenance of the whole system.

The putting into operation of the municipal conduits and the new lighting system on St. Catherine and Bleury Streets, and Park Avenue has enabled the city to remove a considerable part of the unsightly poles and overhead wires from these streets, and the remainder will be removed as soon as conditions permit. The clearing away of this aerial equipment, of which there was a great quantity, has greatly improved the appearance of the streets—especially when seen at night under the brilliant illumination of the new lights. The clean and uncongested appearance of St. Catherine Street as compared with that of former days is especially noticeable.

As soon as the Municipal Conduit System is extended over other districts the new lighting system will also be extended. The districts now under consideration are the section of the city bounded by Commissioners, Notre Dame, McGill and St. Lawrence Streets, and the district comprising St. Lawrence Boulevard from Craig Street to Sherbrooke Street. The work of preparing the estimates, plans and specifications for the new system and the general supervision of the installation was under the direct charge of Mr. Arthur Parent, superintendent of the Light Department, and Mr P. S. Gregory, his assistant.

The removal of the poles and wires above referred to was only possible owing to the construction of underground conduits. In the spring of 1913 tenders were first called by the Electrical Commission for the installation of the conduits. Contractors from many sections bid on this work, G. M. Gest, Limited, being the successful tenderers.



Design of Montreal's new lighting standards

The first installation was made on St. Catherine Street from Guy Street to Papineau Avenue, conduit being placed in the sidewalks on both sides of the street with runs at each intersecting street, while at very important corners these runs were placed at each side of the intersecting street. Later in the same year the ducts were extended on St. Catherine Street from Guy Street to Atwater Avenue, and a system was also installed on Bleury Street from Craig to Sherbrooke Streets, on both sides of the streets, and on Park Avenue from Sherbrooke Street to Pine Avenue, but on the west side of the street only.

The following year the downtown section was constructed on Notre Dame, St. James and Craig Streets from St. Lawrence Boulevard to McGill Street and Victoria Square, including all intersecting streets within these limits, and Fortification Lane. G. M. Gest, Limited, made this installation, as well as that on the two preceding contracts, and in the meantime completed another contract on St. Lawrence Boulevard from Notre Dame, southward.

It was during the construction of the downtown section that the war started, and the work was ordered closed, but through the negotiations of G. M. Gest, Limited, with the city of Montreal, the former carried on their work successfully, thereby giving employment to many men.

In all the conduit contracts the same general type of construction has been used. Three and one-half square bore

15 duct run showing concrete encasement.

tile duct has been used for all light and power cables, excepting that for the services into the buildings, which are of 3½-in. fibre. The top ducts for the police and fire alarm signal wires, street lighting, Gresham Guarantee Company, are 3½-in. fibre, and are separated by a concrete fill from the balance of the system. The ducts are all enclosed in a three-inch concrete encasement, and graded to drain through the manholes at each end.

Main and service manholes are of concrete of octagonal shape, the 6 ft. x 8 ft. holes occurring at street intersections, with service holes 4 ft. x 6 ft. located between street corners, providing for services into all buildings. Each hole is drained through a trap and connected to the street sewer, thereby affording perfect drainage through the whole system. Ventilated covers are provided and these are of such design as to give sufficient strength without being unduly heavy.

Each of the operating power companies is provided with its own transformer manholes, which in general are about 10 ft. x 12 ft. with 8 ft. headroom. These are located in the side streets and are connected with the main manholes by fibre pipes. They have covers made in three sections of ample size to admit of transformers being placed. These holes are also of concrete and are connected to the sewer through a trap.

Owing to sub-surface conditions of many of the streets,

St. Catherine Street, Montreal.

it seemed at times almost impossible to place some of the intersecting runs and manholes, as the streets were already filled with the sewer, gas and water pipes on each side, the duct systems of the Montreal Light, Heat & Power Company, and the Bell Telephone Company. However, the past experience of the conduit contractors was of great service in overcoming these obstacles, and in no instance was it found impossible to make an installation as required.

The Bleury Street and Park Avenue section differed from that of the other streets in that a portion of the system was made jointly with the Bell Telephone Company, having separate ducts and manholes. These joint holes had a common wall, but with enough offset on each side to allow ducts to take care of the distribution in intersecting streets.

The telephone ducts are of multiple tile, and at all points are separated from the power ducts by at least six inches of concrete and gradually fanning out to reach the manholes. In addition to the power company having cables in the municipal ducts, the street lighting occupies a duct as also the fire alarm system. Ample space is provided so that future electrical needs can be taken care of without undue crowding.

It is the plan of the Electrical Commission to gradually extend the conduit system over the entire city of Montreal, removing all overhead wires and poles, thereby making Montreal entirely free from delay and danger to which it had been subjected in the past.

Ninety-one members of the Corporation of B. C. Land Surveyors have become members of overseas forces since war broke out. Four have been killed in action, four have been wounded, and two are prisoners in Germany. Among the wounded is Lieut. P. D. Booth, Royal Field Artillery, who has been awarded the military cross for bravery at the Dardanelles.

Regulations Respecting Highways

Ontario Department Issues Rules for the Guidance of Road Superintendents and Engineers in County Road Construction and Repairs

The following are the Regulations of the Department of Public Highways with respect to county road construction, maintenance and repair under The Highway Improvement Act and The Ontario Highways Act, upon compliance with which the county becomes entitled to the Provincial subsidy payable under the said Act:—

County Supervision and Records

1. The management of all road improvement, maintenance and repair is to be centralized in a capable county road superintendent appointed by and acting under the direction of the county council. A foreman is to be placed by the superintendent in charge of any works which he cannot personally oversee.

2. An approved system of keeping road accounts is to be adopted showing the extent and location of each work of improvement, and the cost of labor and materials used. Expenditures for maintenance and repair are to be kept separate and distinct from construction costs. Time sheets and time books are to be used for the payment of men. Such returns, reports and statements respecting all details of work, methods and expenditure, are to be supplied to the Department of Public Highways as may from time to time be required. Blank forms for annual returns will be supplied to superintendents or other officials upon request.

Departmental Returns

3. Returns to the Department of Public Highways are to show definitely, according to township, lot and concession, the location and terminal points of the work done; thereafter, similar work of construction for that road is not to be a charge upon the Province. Each section of road is to be fully completed at one time unless circumstances do not permit. A repeated charge for any class of work, such as draining, grading, metalling, etc., will not be allowed as construction; but when reported complete by the superintendent is to be regarded as finally completed for that class of work on the defined section of road.

4. Statements of annual expenditure are to close on December 31st of each year, and are to be transmitted to the Department of Public Highways as soon thereafter as circumstances will permit.

GENERAL CONSTRUCTION

5. Improvements are to be of a character suited to the requirements of the district as regards the amount of travel, nature of the soil, quality of road metal available, and other local conditions.

6. Construction is to be guided by the last revised "Handbook of Roadmaking" issued by the Deputy Minister of Highways, except as more specifically stated in these regulations.

7. Work on old gravel or stone roads of the nature of reconstruction or repair may consist of:—

(a) Grading by cutting away shoulders of earth and sod at the sides, and improvement of drainage.

(b) Grading, draining and metalling with good gravel or broken stone, or other approved surface material.

8. Work on new roads may consist of:—

(a) Grading and draining.

(b) Grading, draining and metalling with good gravel or broken stone, or other approved surface material.

9. General construction is to be in continuous stretches of not less than one mile in length. Unless for unavoidable reasons, work done on shorter sections will be rated as maintenance.

10. The road allowance, before construction is undertaken, is to have a minimum width of 66 feet between fences.

Grading and Earthwork

11. It is essential that all roads be permanently graded and earthwork completed before putting on gravel, broken stone or other surface material. Old gravel and stone roadbeds are not to be unnecessarily injured or destroyed by being covered with earth and sods from the sides. (Vide section 26). Roads are to be given easy, flowing, uniform grades, cutting down hills and knolls, and filling depressions. The standard grade shall be 4 per cent., but a maximum rise of 8 per cent. may be permitted by the Department. Thorough grading is insisted upon.

12. The roadway graded for traffic is to be as straight as practicable, and in the centre of the road allowance, with a uniform width between the inside edges of the open ditches, and the superintendent shall see that work is carefully staked out for this purpose in advance of draining, grading and metalling.

13. The width of the graded roadway, shoulder to shoulder between ditches, should not be less than 18 feet for least travelled single-track roads; and roads of heavier traffic should be graded to a width of 24 feet if for single-track and 27 feet if for double-track.

14. Side slopes are to be suited to the natural stability of the soil, but are to be not less than one and one-half feet horizontal to one foot vertical.

Finished Camber or Crown

15. The crown or camber given the newly graded and consolidated roadway is to be uniform, and on single-track roads is to have a rise of one inch to the foot from the shoulder of the ditch to the centre of the road. On double-track roads metalled with broken stone and thoroughly consolidated by rolling, a crown of one-half inch to the foot will be sufficient. Special care is to be given to the crown at or near the top of hills and at the foot. The crown on hills is to be sufficient to turn the water to the gutters and prevent it from following the wheel tracks. In resurfacing old gravel and stone roads, the camber of the consolidated surface should be not less than one-half inch to the foot.

Foundation

16. Stone and gravel roads should have an adequate foundation adapted to the strength of subsoil and the probable weight and frequency of traffic; the upper four inches of consolidated material to be regarded as the wearing surface, and the remainder of the road crust, with the subsoil, to be considered as the foundation.

Gravel and Broken Stone

17. Road metal (gravel and broken stone) is to be placed in the centre of the grade to a width and depth sufficient to form a serviceable road, having due regard to the character and extent of traffic. Single-track roads shall preferably be metalled to a width of ten feet, and double-track roads to a width of eighteen feet.

18. The gravel or stone spread on the road should not be of a less width than eight feet, nor of a less depth than eight inches.

19. The gravel or broken stone used on the road should

preferably be obtained in the vicinity of the road, but must be of good quality.

20. The stone used may be broken field stone, quarry stone, crushed and screened gravel or natural gravel of good quality, care being taken to select a durable quality such as will withstand wear and exposure to the atmosphere, discarding weathered limestone, friable sandstone, or other weak metal.

21. Gravel is to be clean, moderately coarse and free from an excess of clay, sand or earthy material.

22. In applying natural pit gravel containing many large stones, the large stones are to be raked forward from the loose gravel, spreading them so as to be underneath the next load and in the bottom of the road.

23. The gravel or broken stone placed on main roads is to be thoroughly rolled. Roads of less importance, if not rolled, are to be maintained by raking, or trimming with a grader until consolidated by traffic. Each county shall have at least one steam roller.

24. Stone when crushed is to be elevated into bins, from which it can be conveniently and quickly loaded into wagons.

25. Clay, sod or other earthy material is not to be used as a surface dressing or binder on broken stone roads. Stone screenings are to be used for this purpose. Care is to be taken that an excess of this surface dressing is not used.

26. Where roads have heretofore had gravel or broken stone placed on them, they should be reconstructed or repaired by cutting off shoulders with a grader and adding a sufficient amount of gravel or broken stone to fill ruts, depressions, properly crown and make a road sufficiently strong to accommodate the travel. The sod and soft material is to be thrown outward, never drawn to the centre.

Drainage

27. Good drainage is of primary importance. Open drains are to be provided at both sides of the road, with a constant fall to a free outlet, and with sufficient capacity to carry away surface water.

28. Tile under drains are to be laid to carry away excessive subsoil water, lower the water-line, and secure a dry roadbed wherever a moist, damp or springy condition of the subsoil exists.

Bridges and Culverts

29. Durable sluices and culverts are to be built when necessary. Bridges must be substantial in character, preferably of concrete or steel.

30. Bridges are to comply with the approved specifications of the Department of Public Highways; all forms of tender, specifications, and the work throughout, are to be in charge of an engineer qualified to see that such specifications for steel and concrete bridges are carried out. Wherever practicable, bridges are to be built by contract, for which tenders shall be received after due public notice has been given.

Machinery and Miscellaneous

31. Modern roadmaking machinery, equipment, implements and plant are to be used so as to secure the greatest results from the expenditure, and to do the best work. Machinery and other equipment is to be sufficient only for proper construction, maintenance and repair, and authority to purchase is subject to approval.

32. Work is to be carried on in such manner and at such rate as will ensure completion of the designated system of roads without unnecessary delay and within a reasonable period, consistant with the local extent and cost of construction.

33. When in any county the roads assumed as county roads are not of equal importance, they may be classified, and the nature and extent of improvement to be carried out on each class designated by the Department of Public Highways. Provincial liability shall thereafter be limited to the cost of improvement so designated.

34. All plans of road construction, systems and means of carrying on the work, contracts and specifications pertaining thereto, are to be such as will produce durable construction with economy of outlay, and are to be submitted for and shall be subject to approval.

35. Whenever a concrete, brick, bituminous, wooden block, stone block, or other durable type of surface is considered desirable by the county authorities, rather than a water-bound broken stone or gravel roadway, specific approval must be obtained for such construction, together with approval of plans and specifications.

MAINTENANCE AND REPAIR

Repair

36. For small repairs the county shall employ patrolmen to take charge of definite sections of all heavily travelled roads. The length of each section may vary with traffic and general requirements of the road, as experience may determine, but the number of men so employed, and the section allotted to each, shall be such that the system of roads will be kept in an efficient state of repair.

37. Patrolmen may work singly or in pairs as the superintendent may direct, and shall be subject solely to the instructions of the superintendent.

38. Patrolmen employed by the county are to be industrious, honest, sober, and of practical ability so that they will give full value in service for every dollar received. Failure in these particulars is to be met by dismissal by the superintendent.

Duties of Patrolmen

39. For purposes of repair, suitable gravel and stone will be supplied by the county, preferably in piles along the roadside, for use of the patrolmen.

40. For the repair of depressions, holes and wheel tracks, stone of the largest size possible is to be used, up to 2-inch gauge, and stone dust and chips are to be used for binding. The use of clay, loam, sods or earthy material of any kind is prohibited.

41. Holes and depressions in the road surface are to be filled promptly, using the same material as was employed for construction, viz.: gravel for gravel roads, and broken stone for stone roads.

42. Ruts and holes should be so filled that there will be neither a lump nor a depression when the new material is consolidated.

43. Deep holes in gravel and stone roads should have earth and soft material cleaned out of them before filling with new metal.

44. Loose stones are to be raked from the surface of the road, collected in piles, and thereafter used in the improvement of the road.

45. Sod, loam or earthy material is under no circumstances to be drawn from the shoulders to the surface or centre of a stone or gravel road.

46. When it is necessary to place loose gravel or stone on a road (without rolling) the wheel tracks are to be raked full from time to time until the road surface has been consolidated by traffic.

47. Ditches and drains are to be kept clean and free from obstruction.

48. Attention is to be given at all times not merely to keeping the existing drains in the condition following construction, but to improving such drains wherever practicable so that water will not remain in depressions on the road or roadside.

49. Special care is to be taken that the shoulders of the road are kept smooth and free from weeds so that surface drainage is not impeded.

50. Snow and ice are to be removed from the ends of

drains and culverts, and drainage outlets are at all times to be carefully watched to see that they are not obstructed by leaves, weeds, silt or other material.

51. Brush and noxious weeds are to be cut and burned, or otherwise removed from the roadside.

52. Brush is to be cut at all cross-roads, bridges, railway crossings, curves or other points of danger.

53. Floors of bridges and culverts, the approaches to bridges and culverts, and all guard rails are to be kept in repair by the patrolman.

54. The patrolman is to promptly provide protection in case of washouts or other emergency, and to place red lights, notifying the superintendent immediately of any such conditions.

55. Unauthorized signs erected within the road allowance are to be removed if so directed by the county road superintendent.

56. The patrolman for water-bound macadam or gravel roads is to supply a horse and light wagon (or cart), and is to have a shovel, rake, scythe, pick, heavy broom, tamper, and such other tools as he may from time to time require. Where tar or heavy oil is used, the foregoing are to be supplemented with the necessary equipment in accordance with the quality of material used.

57. The patrolman will be held responsible for tools provided by the county, which are to be kept suitably protected and in proper repair.

58. Snowdrifts are to be shovelled out by the patrolman, and when help is needed to do this work promptly, he should engage the necessary assistance.

59. The patrolman should keep a time-book showing time employed on the road, and nature, location and amount of work performed. The time-book should be mailed or sent each week to the superintendent (and by having two such books they can be used for alternate weeks).

Maintenance

60. The maintenance of roads (as distinguished from small repairs) and including re-surfacing, oiling, widening or other improvement authorized by the Department, is to be adequately and promptly carried out by the county, so that unnecessary injury will not result to the road from neglect.

61. The work of maintenance is to be performed under the general organization and regulations provided for first construction in so far as applicable, the county preferably to have one outfit under a foreman, with suitable tools, equipment and workmen, continuously engaged on such maintenance, or construction and maintenance, during the working season.

62. Earth roads prior to metalling may be maintained by the systematic use of the grader and drag.

63. Work of repair, such as the removal of sod shoulders and occasional cleaning of ditches, which can be cheaply done by machinery, is to be done by the maintenance outfit rather than by the patrol system.

Special Local Conditions

64. Where, owing to special local conditions, any departure from the foregoing regulations may be desired, upon application to the council or superintendent to the Deputy Minister of Highways, an examination of the road or roads or circumstances in question will be made by an engineer of the Department for the purpose of deciding with regard thereto.

Interpretation

65. In these regulations relating to construction, maintenance and repair of county roads, "superintendent" shall mean county road superintendent appointed by the county council in accordance with section 7 of the Highway Improvement Act.

66. "Approved" or "approval" shall mean approval by the Deputy Minister of Highways, whose decision as to the scope, intention and interpretation of these regulations, or any part thereof, is to be final.

67. "Old" roads include such highways as have been previously well graded and metalled with gravel or broken stone, and which have a solid and deep roadbed. Former toll roads, and roads of a similar character will usually fall within this class.

68. "New" roads in general include earth roads which may or may not have been previously graded, and which have had little or no gravel or stone placed upon them.

69. "Single-track" roads shall be those metalled from 8 to 12 feet wide, and "double-track" roads shall be those metalled more than 12 and up to 18 feet wide.

70. "Repair" shall mean the mending of holes and ruts, the cutting of weeds, the cleaning of ditches and gutters, the raking of loose stones, and such mending as is necessary to keep the road smooth and in good condition for traffic, and to prevent rapid deterioration.

71. "Maintenance" shall relate to the uniform wear of the road under traffic, and the periodic expenditure and work necessary to re-surface and restore the road crust to its original thickness, or may include the widening or strengthening of the road crust made necessary by increased traffic, also oiling or the use of bituminous or other carpet-coat materials to protect the road and prevent dust after first construction.

72. "Department" shall mean the Department of Public Highways of the Province of Ontario.

Trade Inquiries

Names and addresses may be obtained from the Department of Trade and Commerce, Ottawa.

320. Asbestos cement sheets—A London firm of engineers are in the market for 250,000 square yards of asbestos cement sheets, 3/16 in. thick, and invite quotations from Canadian manufacturers.

324. Brass steam fittings—A Glasgow firm wishes to obtain the representation of a Canadian house for the above. Satisfactory references.

325. Steel billets and wire rods—A Coatbridge firm asks for Canadian sources of supply.

326. Rolled steel joists; bars of all sections, rivets and bolts. A Glasgow house will be glad to receive catalogues and quotations c.i.f. Glasgow quay.

327. Steel joists—A large Glasgow firm would be pleased to receive quotations for say 150 tons steel joists to the following sections, or nearest procurable sizes: 9 in. by 4 in. by 21 pounds; 8 in. by 4 in. by 18 pounds; 7 in. by 4 in by 16 pounds; 6 in. by 3 in. by 12 pounds; 5 ins. by 3 in. by 11 pounds; all in 40 ft. lengths.

328. Galvanized fencing wire—A Glasgow firm desires to know if galvanized fencing wire can be obtained from Canada. Supplies formerly procured from Belgium.

330. Tinned steel mattress wire—A firm at Liverpool manufacturing wire mattresses would like to receive quotations from Canadian manufacturers of tinned steel mattresses wire in 21½, 22½ and 23 standard wire gauges.

329. Iron or steel bars—A Glasgow firm is open to purchase iron or steel bars notably bulb tee bars 1½ by 1½ equal 2½ pounds per foot, and varillas ¾ in. by ½ in by 8 oz. /ft.

339. Representation—A gentleman in New York who has travelled throughout Asia, the Pacific Islands and Australia for the past seventeen years in the interest of certain United States manufacturers, desires to be put in touch with Canadian manufacturers who are anxious for export trade, since he has had many demands on past trips for goods manufactured in Canada.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

After eighteen months of silence "Industrial Canada," the mouthpiece of the Canadian Manufacturers' Association, has joined its voice to those of other journals that could not stomach what went on at Ottawa in connection with the letting of contracts for shells and fuses by the late Shell Committee. "Industrial Canada" tells us in its latest issue a few things it knows about fuse contracts and says that eighteen months ago the Canadian Manufacturers' Association went to the Government and tried to make it realize that the "license to loot" ought to be terminated. Their warnings, like those of many of the Government's political supporters were, according to "Industrial Canada" allowed to pass unheeded. So, at this late date, after giving the matter eighteen months of silent thought, the organ of the Canadian Manufacturers' Association, the members of which are both liberal and conservative, comes into the lime-light with its statement of some of the things that have come under its notice.

* * *

I will outline the story told by "Industrial Canada" a little later on, after I have said what I feel about the part this mouthpiece of the manufacturers has been taking. While the making public of this story is better late than never, I cannot help wondering how such a journal can square itself with its own conscience for having kept silence all these months. It seems to me that this is just another example of the weakness exhibited by 90 per cent. of the journals of Canada in failing to do their plain duty. What is a public journal for, if it is not to tell the public some of the plain facts about its public men, especially when the good name of the country is being soiled? When the testing time comes, many of these journals lack the backbone, or the nerve to speak out. They act the part of Falstaff whose chief maxim was the comfortable idea that "discretion is the better part of valor" and they just keep mum. They wait until the burglar gets away with the swag, and finally, when so much has been filched from the public purse that no one can shut his eyes to it any longer, some of them join in the chase with a great hue and cry.

Why did not "Industrial Canada," in the interests of manufacturers, make its public protest eighteen months ago, when the trail was hot and there was some prospect of getting hold of the culprits before they cleared off with whole skins and a big swag? It was left to this paper—the Contract Record—to make the first protest in the interests of the manufacturers of Canada, and in the interests of clean government and the good name of the people of Canada; and for some time it was left to us also to continue the protest almost alone. The Canadian Manufacturers' Association, through their organ "Industrial Canada," made their protest silently and without effect eighteen months ago. They should have followed this up at that time with a public statement, instead of waiting for eighteen months and watching the continuation of those evils about which they told the government in a whisper.

I do not relish the idea of saying much about my own doings, but I may be excused for pointing out such shortcomings on the part of other journals, and saying, that in spite of my own loneliness all these months, I have felt, and still feel, that I have been doing the Canadian manufacturers and the Canadian public a real service in laying bare some of these ugly truths; a service which the public had a right to expect, the manufacturers especially, from those other journals, and more especially from their own industrial mouthpiece.

* * *

Here is the story of "Industrial Canada," told as briefly as we can put it:—Eighteen months ago the Canadian Manufacturers' Association approached the Government and told them some of the things they knew about the way in which fuse contracts were being given to Americans and refused to Canadians, and what people were saying about it all. "The reception given these suggestions, says Industrial Canada, "was not of a character calculated to invite further co-operation."

"There are limits," Industrial Canada continues, "to the patience of loyal citizens even in war time, and much as we may deplore the disgrace that the fuse scandal has brought publicly home to Canada, and warmly as we may resent the effort to make political capital out of it at a time when our national energies ought all to be centred on winning the war, there is no getting away from the fact that the situation was intolerable, and that the license to loot had to be terminated."

After a little more in the way of an introduction, the article continues, saying that Mr. T. A. Russell and Mr. Lloyd Harris, of the Russell Motor Car Company, Limited, heard in April, 1915, that fuse contracts had been "going begging," since November, 1914. Their first information about it was received in New York from Sir Sam Hughes, who, by personal introduction referred them to Col. Allison in the Manhattan Hotel for details. Preferring to do business direct with the Shell Committee, Messrs. Russell and Harris went to Montreal and made overtures to the Committee through Gen. Bertram and Col. Carnegie." The upshot of this business was that they were again referred to Col. Allison, "who was said to have the matter in hand for prospective contractors in the United States." After considerable perseverance and general rebuffs, Messrs. Russell and Harris "were given a promise that one million of the five million fuses required would be held, pending the receipt of a tender from them, providing that tenders were submitted within a reasonable time." A reasonable time in their case "was defined as two weeks, notwithstanding the fact that Allison had presumably been busy on the proposition for five months without being able to offer anything definite."

Within the two weeks Messrs. Russell and Harris notified the Shell Committee that their proposition would be ready on the date specified. "And now for the fact that requires explanation," continues the article in Industrial Canada. "On May 25th, 1915, the Russell tender was turned in, offering to make 1,000,000 fuses at $4.20. On May 19, without waiting for this competitive tender, which was known to be on the way, and regardless of the promise given to hold at least a portion of the business open, the committee awarded contracts for the whole of the 5,000,000 fuses to the companies promoted by Allison and his associates, a small fraction of them at $4.00, but the majority of them at $4.50. The loss in money is a matter of easy calculation from the records of the committee. The loss in time of delivery is also determinable, because whereas the United States contractors have fallen far behind with their obligations, the Russell Motor Company are now delivering ahead of time under a contract they subsequently secured at $3.70. The indirect loss to Canada and to the Empire through the sacrifice of domestic to foreign enterprise is beyond computation."

* * *

It is unnecessary to comment on this story at present.

It simply adds a chapter to many that I have already published. Nor is it necessary to say much about the characters of the parties who are referred to as taking part in it. The fact that one of these parties is Mr. Lloyd Harris, stamps the story as deserving of every confidence. Mr. Lloyd Harris is one of the brightest and cleanest men we have in Canada today, and there are a good many others of his type. The thing that I cannot quite understand is why he, or others of his calibre, were not employed by the government in this crisis. Can it be that he was too big a man for them? Whatever reply you give to this question, the Dominion Cabinet needs a good cleaning out, if the conservative party is to be saved from defeat.

* * *

Just by way of an example of the above idea, I may mention the case of Hon. A. E. Kemp, the chairman of the Purchasing Commission, who also has been acting Minister of Militia during the absence of Sir Sam Hughes. Is it in the interests of the people that a man who is so interested in companies selling goods to the Government should be occupying an important position on a Purchasing Commission? Is there not even a sufficiently vigorous public opinion in Canada to teach such men that their positions as members of Parliament are positions of trust, to be exercised for the public welfare, not positions of profit to be utilized in their own interests? Does it not make you question whether the men who get to the top of the tree in our political life are men of the large calibre they should be? In the name of Heaven, are there no big men in this country who could handle our affairs more after the manner in which we have every right to expect they should be handled?

SEARCHLIGHT.

Personal

Mr. William G. Murdoch, city engineer of St. John, N.B., delivered an instructive address to the engineering students of the University of New Brunswick on the 17th inst., his subject being the Suspension Bridge.

Mr. J. Quail, formerly sales engineer for the Manitoba Bridge and Iron Works, has accepted the position of manager of the western office of the Canadian Bridge Company, of Walkerville, Ont. His office will be in the Garry Building, Winnipeg.

Mr. H. V. Keating, civil engineer, Fort Frances, Ont., has charge of the construction of a large paper mill for Warren Curtis, of Thorold, Ont., to be built about sixteen miles from Shelter Bay, on the lower St. Lawrence, below the island of Anticosti.

Mr. E. J. Lennox, a Toronto architect, has received a judgment for $1,309 against the Russell Motor Company. Five years ago Mr. Lennox was entrusted to prepare plans for a factory for the defendant company, and the action was for recovery of money due on the work.

Mr. W. H. Fairchild, the newly-appointed city engineer of Galt, Ont., has had a long and varied experience in his profession. He is a native of Brant county, and started his engineering career in 1895 with City Engineer Jones of Brantford. After four years' training he moved to Simcoe, where he engaged in private practice and received the appointment of engineer for the counties of Norfolk and Haldimand. In 1907 he returned to Brantford, and controlled practically all the engineering outside the city of Brantford in the counties of Brant, Norfolk, and Haldimand. In 1913 Mr. Fairchild went to Vancouver, where he had charge of the Pacific Coast Freight Buildings for the C. N. R. On the outbreak of war, work ceasing on this job, he went back to Brantford, where he practised his profession until appointed city engineer of Galt.

Mainly Constructional

Owing, it is said, to lack of competition, the price of cement in Calgary is 23 cents higher than in Edmonton.

The town of Dundas, Ont., are considering the installation of a sewerage system, and have engaged Messrs. Murray & Lowes to prepare plans and estimates.

Work that will run up to a quarter of a million dollars is in sight already in South London, Ont., and a very busy season in the building line is expected. A large number of splendid residences are being erected.

The Ohio State Highway Department has made the first important awards of the season of state highways work. The amount of the contracts exceeds $1,250,000 and the work covers more than 90 miles of roads in many counties.

The property of the Nova Scotia Car Works, Limited, Halifax, N. S., is to be sold for the benefit of creditors. The company's liabilities amount to $347,000. It is understood that the Nova Scotia Steel and Iron Company are desirous of securing the property.

It is now said that the Nova Scotia Steel and Coal Company are about to embark upon the steel ship-building industry, and that this was the reason for the increased capitalization of the company which was authorized at the annual meeting a few weeks ago.

Thomas Kelly, the Winnipeg contractor, has lost his fight against extradition in the Supreme Court at Washington, and will have to return to Winnipeg to face a charge of having obtained $1,250,000 by false pretences in connection with the Parliament Buildings contract.

The Blystone Manufacturing Company, of Cambridge Springs, Mass., are considering the erection of a factory shortly in Niagara Falls, Ont., on a site purchased by the company a year ago. The company manufacture concrete mixing machinery, and the Niagara Falls plant will be used as an assembling department of the main factory in Philadelphia.

Mr. E. W. Bowness, of the Edmonton Power Company, is on his way to England, where he will consult with the head office of Sir John Jackson, Limited, regarding the city's power scheme. Mr. Bowness states that on his return, some time in May, the work on the railway end of the project from Edmonton to Blue Rapids will be commenced immediately.

Bradstreets report that building permits for ten Canadian cities in March numbered 339, with a total value of $745,515, this being a decrease of 52.3 in the number, but an increase of 6.4 in value. For the first quarter of 1916 permits totalled 660, with a value of $1,367,219, a decrease of 48.7 in number and of 26.5 in value. At the same time 149 United States cities showed a decrease of 20.2 per cent. in value.

The city of Edmonton has constructed at the foot of 101st Street on Ross Flats a sewage disposal plant at a cost of $50,000. The plant is being completed along experimental lines, and thus serves the double purpose of treating part of the city's sewage and acting as a guide in the design of larger plants which will be constructed later. The new activated sludge process of sewage purification is being tried.

Mr. M. H. MacLeod, general manager of the Canadian Northern Railway, has completed arrangements for the west coast terminal facilities of the railway, and a million-dollar station at Vancouver will be commenced in a few weeks. The station will provide for development of the railway, being planned to meet all possible requirements for many years. In addition to this, the company are undertaking a car ferry service from Vancouver to Vancouver Island, part of which will be in operation next month.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Dundas, Ont.
The Town Council will submit two by-laws to the ratepayers on May 2nd to authorize the construction of sewers at an approximate cost of $74,600, and a sewage disposal plant, estimated to cost $38,600. Engineers, Murray-Love Company, Toronto.

Hamilton, Ont.
The City Council intend to commence the construction of a watermain on Cumberland Avenue as soon as the permission of the Provincial Board of Health is obtained. Estimated cost, $3,300. Engineer, A. R. Macallum.

Leamington, Ont.
The Town Council propose to lay a concrete pavement on Russell Street.

Levis, Que.
The City Council propose to extend the watermain system at an approximate cost of $9,000. Clerk, L. Lemieux.

The City Council propose to construct artesian wells at an approximate cost of $25,000 and to lay pavements estimated to cost $35,000. Engineer, C. Lessard.

London, Ont.
The City Council are considering the construction of the following works:—asphaltic concrete pavement, $9,500; concrete pavement, $4,500; 4-inch watermains, $10,000. Engineer, H. A. Brazier.

Merritton, Ont.
The Riordan Pulp & Paper Company are receiving tenders on laying about 1,500 feet of 30-inch cast iron pipe.

Ridgetown, Ont.
The Town Council will shortly submit a by-law to authorize the construction of improvements to the waterworks system, estimated to cost $10,000.

St. Hyacinthe, Que.
F. E. Field, Atwater Avenue, Montreal, is preparing new plans for mechanical gravity filters, with a capacity of 4,000,000 gallons daily. Estimated cost, $75,000. Tenders will be called in May.

Toronto, Ont.
The Commissioner of Works has recommended the construction of asphalt pavement on Heintzman and Lansdowne Avenues, to cost about $15,640.

Vancouver, B.C.
Tenders will be called immediately for the construction of the proposed Stanley Park Causeway and trunk sewer across the harbor for the City Council and the Vancouver Sewage Commission.

The Vancouver & Districts Joint Sewerage & Drainage Board, 718 Granville Street, propose to construct a trunk sewer at Stanley Park by day labor. Approximate cost $300,000. Tenders will be called for cement, sand and gravel. Engineer, A. D. Creer.

CONTRACTS AWARDED

Collingwood, Ont.
In connection with extensions to the waterworks system, the contract for supply of pumping machinery has been let to the Turbine Equipment Company, C. P. R. Building, Toronto, and the contract for pump well and connections to H. G. Wynes.

Cornwall, Ont.
The Township Council have let the contract for the construction of a drain to Hilliard McLean, Cornwall. Approximate cost, $9,000.

London, Ont.
The City Council have let contracts for sewer construction to the following firms:—Mitchell & Mohan, 150 Wharncliffe Street, $2,058; Johnson & Agnew, 153 Kent Street; J. Murphy, Hyman Hall, $4,000.

Railroads, Bridges and Wharves

Perth, Ont.
Tenders on the construction of concrete abutments and flooring for a proposed bridge over the River Tay will be received until noon, May 1st, by the Town Council. Clerk, John A. Kerr.

St. Marys, Ont.
The Grand Trunk Railway propose to build a steel and concrete bridge over the tracks at Queen Street. Approximate cost, $6,000. Particulars from Charles Forrester, care of the Company, Stratford.

Tenders will be received until May 1st for the construction of a woven wire swing bridge with cement abutments for the Town Council. Clerk, T. M. Clark.

Sunbury County, N.B.
Tenders on the erection of a bridge will be received until noon, May 3rd, by John Morrissy, Minister of Public Works, Fredericton. Plans at Government Rooms, St. John, with Felix Smith, Central Blissville, T. B. Hart, Fredericton Junction, Fred Davis, Oronocto, and at the Department.

Public Buildings, Churches and Schools

Addison, Ont.
B. Dillon, Architect, King Street, Brockville, is receiving tenders on the erection of a church. Estimated cost, $5,000.

Brantford, Ont.
The Roman Catholic Church are considering the erection of a school at Colborne and Brock Streets, to cost about $12,000. Architect not yet appointed. Pastor, Rev. P. J. Padden.

Chatham and Dover Townships, Ont.
Tenders will be called very shortly for the erection of a school for Union School Section No. 15. Architects, Adams & Adams, Market Chambers, Chatham. Approximate cost, $3,500. Cement block and brick construction.

Joliette, Que.
The Provincial Department of Public Works propose to build an annex to the Court House, and plans are being prepared by George St. Michel, Parliament Building, Quebec. Stone and brick construction. Approximate cost, $12,000.

London, Ont.
The School Board propose to instal a boiler at the new Technical School which will necessitate the erection of a large chimney, and will also be in the market for iron and woodworking machinery, electrical apparatus and equipment.

Moncton, N.B.
The City Clerk, J. S. McGee, is receiving tenders on the installation of seating at the City Hall.

Ottawa, Ont.
Millson & Burgess, Union Bank Building, are preparing plans of sun parlors to be erected for the City Council, and will call for tenders very shortly. Stucco and brick construction. Approximate cost, $10,000.

Peterboro, Ont.
William Blackwell, 372½ Water Street, has prepared sketch plans of a church for St. James Methodist Church. Approximate cost, $25,000.

Port Credit, Ont.
The Town Council have been asked to provide funds so that the School Board can proceed with the erection of a school, estimated to cost $20,000. Architects, Designing & Draughting Company, 54 Adelaide Street E., Toronto.

St. Antoine de Bienville, Que.
Tenders on carpentry, plastering and electrical work at the Parish Church will be received until April 29th by the Curate, Rev. D. Pelletier. Architect, P. Levesque, 115 St. John Street, Quebec. Approximate cost, $30,000.

Timmins, Ont.
The plans for the proposed school are being revised by Ellis & Ellis, Architects, Manning Chambers, Toronto. Approximate cost, $12,000.

W. Simpson, 187 Hillsdale Avenue, has prepared plans for a chapel which he will erect for the Davisville Baptist Congregation. Estimated cost, $3,000. Brick construction.

Union on the Lake, Ont.
Tenders will be called shortly for the erection of an addition to the Essex Tuberculosis Hospital. Approximate cost, $15,000. Architect, J. C. Pennington, La Belle Building, Windsor.

CONTRACTS AWARDED

Belleville, Ont.
The general contract for the erection of a Children's Home has been let by the Childrens Aid Society to L. E. Allen, 198 Bridge Street. Estimated cost, $15,000. Architects, Ellis & Ellis, Manning Chambers, Toronto.

Hamilton, Ont.
The contract for the installation of an elevator at the Mountain Hospital has been awarded to the Otis-Fensom Elevator Company, Limited, Victoria Avenue N.

Kinburn, Ont.
The Public School Board have awarded the general contract for the erection of a brick school to R. A. Kemp, 149 First Avenue, Ottawa. Approximate cost, $10,000.

Moncton, N.B.
The contract for plastering at the new Aberdeen School has been awarded to W. O. Calkin, 647 Union Street.

Montreal, Que.
The general contract for alterations to the Montreal Maternity Hospital, 710 St. Urbain Street, has been let to E. G. M. Cape & Company, Limited, 10 Cathcart Street. Estimated cost, $3,000.

In connection with the basement now being built on Rosemount Avenue for the Trustees of St. Jean Berchmans, Cartier Street, the contract for heating, plumbing and roofing has been awarded to T. Latourelle & Son, Limited, 6 Craig Street W., and the electrical work to J. A. St. Amour, 2171 St. Denis Street.

St. Remi de Tingwick, Que.
The contract for rebuilding the Parish Church has been let to Louis Caron & Son, Nicolet, Que.

St. Thomas, Ont.
In connection with alterations to Wilson Avenue School, the contract for painting and decorating has been awarded to C. L. Lumas, the carpentry to J. Van Horne, and the plumbing to J. B. Hammond.

Westboro, Ont.
The following contracts have been let in connection with the erection of a school on Broadway Avenue:—plastering, T. H. Patterson, 70 Rosedale Street, Ottawa; painting, Higman & Sons, 176 Rideau Street, Ottawa; heating, McFarlane & Douglas, 250 Slater Street, Ottawa; electrical work, H. L. Allan, 377 Somerset Street, Ottawa; masonry, Murphy Brothers, Arthur Street.

Business Buildings and Industrial Plants

Belleville, Ont.
W. S. Cook, 23 Campbell Street, is considering the erection of a storehouse near the Grand Trunk Station.

Blenheim, Ont.
The Springsteen Company intend to erect a garage, and will superintend the work themselves. Approximate cost, $10,000.

Brampton, Ont.
W. E. Down proposes to build a garage this summer, at an approximate cost of $6,000. Steel and brick veneer construction.

British Columbia Province
M. M. Wall, care of the Buffalo Hardwood Lumber Company, Buffalo, N. Y., is considering the construction of a lumber mill in the Yale and Cariboo district.

Calgary, Alta.
The Western Mausoleum Company, Limited, Boyd Building, Winnipeg, are about to start work on the erection of a mausoleum, estimated to cost $400,000. Granite construction, marble interior.

Dundas, Ont.
The Dickson Building Company, King Street, have commenced the erection of a factory on Hatt Street. Brick construction.

Harry Cohen, King Street, is now receiving tenders on the erection of a store and residence, estimated to cost $6,000. Brick and concrete construction. Architects, Ellis & Osborne, Dundas and Toronto, Ont.

Edmonton, Alta.
The Western Mausoleum Company, Limited, Boyd Building, Winnipeg, propose to build a mausoleum at an approximate cost of $400,000. Work may start this summer. Granite construction, marble interior.

Galt, Ont.
Dr. J. A. McDonald has decided to rebuild the Imperial Hotel, and will have plans prepared.

Hamilton, Ont.
The Grasselli Chemical Company have prepared plans for an addition to their factory, estimated to cost $30,000. Brick and corrugated iron construction.

Kentville, N.S.
Perry Bishop is about to build a business block by day labor under supervision of Arthur B. Ward. Frame construction. Estimated cost, $6,000.

Kingsville, Ont.
The Erie Tobacco Company intend to rebuild their premises, which were recently destroyed by fire. Manager, Oliver Fox.

London, Ont.
Tenders will be called early in may for the erection of a warehouse for Webster & Harvey, Richmond and Oxford Streets, for which plans are being prepared by J. M. Moore, 415 Richmond Street. Approximate cost, $12,000.

Markham, Ont.
The Markham Agricultural Society will receive tenders until May 12th for the erection of a building suitable for an agricultural hall and rink. Particulars at offices of James Malcolm.

Montreal, Que.
W. A. Mahoney, Telephone Building, Guelph, Ont., is preparing plans for an addition to the premises of the Canada Stove Company.

New Westminster, B.C.
The City Council will shortly call for tenders on the erection of a market building on Lytton Square. Concrete construction. Approximate cost, $30,000.

Ottawa, Ont.
The Imperial Motor Company, 150 Albert Street, propose to erect an addition to their premises.

Quebec, Que.
Work has been started by day labor on the conversion of a store into a theatre for Delphis Brochu, 63 St. John Street. Estimated cost, $6,000. Architects, Tanguay & Lebon, 20 d'Aguillon Street.

Saskatoon, Sask.
Plans have been prepared for an incinerator to be built for the City Council. It is probable that the contract let in 1914 to Laurie & Lamb, Montreal, will be cancelled and new tenders called. Approximate cost, $100,000. Engineer, G. D. Archibald.

Toronto, Ont.
The Campbell Flour Mills Company, Limited, are considering the erection of a storehouse and cooperage, at an approximate cost of $5,000. Work will include the wrecking of existing buildings.

The Brandon Company, 108 Vine St., have had plans prepared for a machine shop to cost about $5,000. Steel and brick construction.

Whitby, Ont.
The erection of two stores on Brock Street is being considered by W. J. H. Richardson and the Misses Richardson. Brick construction. Approximate cost, $5,000.

Whitebread, Ont.
R. Stenton, Wallaceburg, is about to start work on the erection of a barn, estimated to cost $3,000. Frame and concrete construction.

Windsor, Ont.
Plans of stores and apartments to be built for H. Benstein, 54 Pitt Street E., are being prepared by G. Jacques, Boug Block. Tenders will be received from May 6th to 15th. Brick and concrete construction. Estimated cost, $18,000.

Yarmouth Township, Ont.
J. B. Turner, Edgeware Road, St. Thomas, proposes to rebuild his barns, recently destroyed by fire. Fireproof construction. Approximate cost, $3,500.

CONTRACTS AWARDED

Fenelon Falls, Ont.
The general contract for the erection of three stores for James Fraser has been let to A. McLeod, 57 Benlamond Avenue. Smaller trades will be sub-let. Concrete block construction. Estimated cost, $4,000.

Halifax, N.S.
The general contract for the erection of a machine shop for the Halifax Graving Dock Company, Granville Street, has been awarded to G. M. Brookfield Ltd., Granville Street, and the electrical work to Farquhar Brothers, Barrington Street. Approximate cost, $16,000. Reinforced concrete construction.

Hamilton, Ont.
George Hill, 21 Vine Street, is building a stable, estimated to cost $6,000, and has let the contract for masonry to H. Jones, 29 Macaulay Street E. Contracts will also be let for steel work and roofing.

The contract for the construction of

(Continued on page 47)

Tenders and For Sale Department

To Contractors

Sealed tenders will be received up till noon, **April 26th, 1916**, by the Secretary, for the erection and completion of a six-roomed Public School Building for Finch School Board Section No. 3, in the Village of Finch, Ont.

Drawings and specifications can be seen at the undersigned. The Board reserves the right to reject any or all tenders. The successful tenderer will be required to furnish satisfactory guarantee as to good faith. Tenders will be opened after 8.30 o'clock p.m. May 1st.

GEO. S. CASSELMAN,
16-17 Secretary.

Construction of Cribwork and Concrete Wall

Sealed tenders will be received up to 12 o'clock noon, **Monday, May 1st, 1916**, addressed to the Chairman of the Toronto Harbor Commissioners, 50 Bay Street, Toronto, Ont., and marked "Tenders for Harbor Head Walls."

All information may be obtained by applying to the above address. Tenders received after the time above named will not be considered.

The Commissioners reserve the right to reject any or all tenders received.

E. L. COUSINS,
16-17 Chief Engineer and Manager.

Tenders for Dredging

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for Dredging, Port Hope, Ont.," will be received until 4.00 P. M., Tuesday, May 2, 1916, for dredging required at Port Hope, Ontario.

Tenders will not be considered unless made on the forms supplied, and signed with the actual signatures of tenderers.

Combined specifications and form of tender can be obtained on application to the Secretary, Department of Public Works, Ottawa. Tenders must include the towing of the plant to and from the work.

The dredges and other plant which are intended to be employed on this work shall have been duly registered in Canada at the time of the filing of this tender with the Department, or shall have been built in Canada after the filing of the tender.

Contractors must be ready to begin work within two weeks after the date they have been notified of the acceptance of their tender.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, for five per cent (5 p.c.) of the contract price, but no cheque to be for less than fifteen hundred dollars, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works, Ottawa,
Tuesday, April 22, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—1147.

Tenders for Diaphragm Pumps

Tenders will be received by registered post only, addressed to the Chairman Board of Control, City Hall, Toronto, up to noon on Tuesday, May 9th, 1916, for the supply of Two Gasoline-driven Diaphragm Pumps.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 6, City Hall. Tenderers must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),
Chairman Board of Control.
17-17

CITY OF LONDON, ONTARIO

Storm Sewers and Sewage Disposal Works

Sealed tenders addressed to the "Chairman and Members Board of Control" will be received at the office of the City Clerk until 10 A. M., Friday, **May 12th, 1916**, for the following works:—

Contract 1—Wharncliffe, etc. .....2,300 Lin. ft.
Contract 2—Victoria, etc. ....6,000 " "
Contract 3—Waterloo, etc. ....4,400 " "
Contract 4—Elizabeth, etc. ....3,000 " "
Contract 5—Quebec, etc. ....2,400 " "
Contract 6—East End Sewage Disposal Works.

Specifications, forms of tender, plans, profiles, etc., may be seen at the City Hall, London, or at Room 204 Mail Bldg., Toronto, after May 1st, 1916.

Each tender is to be accompanied by a marked cheque as called for in the Instructions to Bidders.

The lowest or any tender not necessarily accepted.

H. A. STEVENSON, Esq., Mayor.
H. A. BRAZIER, Esq., City Engineer.
CHIPMAN & POWER, Consulting Engineers.
April 24th, 1916.

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

FOR SALE—Asphalt Roller

One "Erie" 5-Ton Tandem Steam Roller, in perfect condition. Used about one week. Full specification and price upon request. P. O. Box 65, St. Catharines, Ont. 16-17

Construction Work

Superintendent or foreman on general construction work (Railway or Canal) on Concrete, Rock and Earth, wants position. Frank Brown, General Delivery, Sub-Station F, Toronto. 16-17

Reinforced Concrete Superintendent

Superintendent for past twelve years. Had full charge of some of the largest plants and buildings. Now open for engagement. A Martin, care of 51 Macpherson Ave., Toronto. 16-17

AGENTS WANTED

Canadian sales agents wanted for best line of excavating outfits made in the United States. Apply Box 393 "Contract Record & Engineering Review," Toronto, Ont. 17-19

Good Form Design Saves in Labor and Lumber on Building Work

Form designs should be arranged to reduce the number of special panels and pieces, should take into account the total quantity required, considering the movement of the forms throughout the job, and should furnish an accurate key to the quantity and size of stock required and to the order in which the component parts should be made, according to a paper presented at the twelfth annual convention of the American Concrete Institute at Chicago by R. A. Sherwin, of the engineering force of the Aberthaw Construction Company.

Such a design requires a careful study of the building plans, with a view to having modified such details as would make the form work unnecessarily expensive, and the immediate preparation of a progress chart. The latter is usually determined by the time allowed for completing the biulding. As soon as it has been prepared, the quantity of forms and the order in which they are to be erected and moved can be determined. This chart also shows when the form design must be ready to allow sufficient time for making up and erection.

A conference is then held between the man in charge of form design and the field men, at which the sizes and kind of lumber that will be cheapest and that can be delivered on time are determined. The point at which work must begin and the location, type and capacity of the concrete plant must also be settled. The general scheme of the form work should be outlined at this conference with field men to make sure that the design is understood and acceptable to them. If this is the case, they can carry it out much more readily. The first study and drawings are made from a general assembly, which is selected from different combinations as the most economical for the conditions. Joists and girts should be in as few lengths as possible. Stock sizes of lumber should be used.

Business Buildings and Industrial Plants

(Continued from page 45)

an ice plant fo rthe City Hospital Board has been awarded to the Canadian Ice Machine Company, 250 Wellington St. Approximate cost, $13,645.

The contract for masonry, carpentry, steel work and roofing required in an addition to the premises of the Zimmerman Manufacturing Company has been let to George Frid Company, 701 Bank of Hamilton Building. Approximate cost of building, $25,000.

The general, masonry and carpentry contracts for an addition to the premises of the Steel Company of Canada, Hess Street North, have been let to R. A. Campbell, 117 Duke Street, and the roofing to T. Irwin & Son, 22 McNab St. S.

London, Ont.
The general contract for remodelling a store for J. G. Steele, Dundas Street, has been let to S. Willis, 765 Talbot St. Estimated cost, $3,500.

Merritton, Ont.
The contract for the construction of an electro-chemical plant for the Riordan Pulp & Paper ompany has been awarded to the John V. Gray Construction Company, 59 Marmaduke Street, Toronto. Estimated cost, $30,000.

Montreal, Que.
The following contracts have been let in connection with the stores which are being built by William Boivin, 317 Fourth Avenue, Rosemount, for E. De Hivers:—mill work, H. Beaucage, Sorel; roofing, Samuel & Frere, 562 Panet Street; heating, plumbing and electrical work, G. Champagne, 78a Inspector Street.

The following contracts have been let in connection with the erection of an emergency hospital for the Montreal Locomotive Works, Limited, Longue Pointe, Montreal: — structural steel, Structural Steel Company, 10 Cathcart Street; roofing, Sibley & Huot, 34 Martin Street; plastering, Watson & Wilson, 1678 Hutchison Street; reinforcing steel, A. H. Cederberg, 10 Cathcart Street; plumbing, L. E. Moulton & Company, Limited, 142 Inspector Street.

Montrose, Ont.
The general contract for the construction of round house, coal dock and other buildings for the Michigan Central Railway Company has been let to Walbridge & Aldinger, Detroit, Mich. Estimated cost, $250,000. Brick and concrete construction.

Ottawa, Ont.
The general contract for constructing gymnasium rooms for the Y. W. C. A. Hintonburg Branch, has been awarded to J. H. White, Eastview, near Ottawa. Approximate cost, $7,000.

In connection with the erection of a power station on Slater Street for the Imperial Realty Company, the contract for construction of building has been let to John Sutherland, 216 Cooper Street, and for supply of steel, boilers, refrigeration plant, etc., to the Campbell Steel & Iron Works, 855 Carling Avenue. Brick and concrete construction. Approximate cost, $30,000.

Peterboro, Ont.
The contract for cement required in the erection of an addition to the premises of the Bonner-Worth Company has been let to H. Shurter, 599 King Street, and the carpentry to William Padgett, 576 Boliver Street.

Pointe aux Trembles, Que.
The general contract for the construction of an oil plant for the Imperial Oil Company, Limited, 918 St. Patrick St., Montreal, has been let to the James Shearer Company, Limited, 225 St. Patrick Street, Montreal. Work consists of an underground viaduct of reinforced concrete, mechanical and stores building, power house, boiler house and transfer pump house. Structural steel will be supplied by the Structural Steel Company, Limited, 10 Cathcart Street, Montreal.

Saskatoon, Sask.
The City Council have let the general, masonry, carpentry, steel, roofing, plastering and painting contracts for an addition to the power plant to James Priel. Estimated cost, $9,882.

St. Catharines, Ont.
The general, masonry, carpentry, steel, roofing and plastering contracts for the erection of an office building for the Waterloo Mutual Fire Insurance Company have been awarded to Casper Braun, 295 King Street W., Berlin. Approximate cost, $5,500.

In connection with the factory now in course of erection for the Dominion Food Company, the contract for steel work has been let to the Hamilton Bridge Company, Bay Street, Mamilton, and the painting to Begy & Son, Company, James Street.

Three Rivers, Que.
The contract for structural steel required in an addition to the plant of the Canada Iron Foundries Ltd., 7 St. Maurice Street, has been let to Canadian Bridge Company, Walkerville, Ont. Remainder of work by general contractor.

Truro, N.S.
R. O. McCurdy, Willow Street, has let the contract for heating and plumbing required in the erection of a store and office to F. Dexter, and the electrical work to W. Conn.

Vancouver, B.C.
In connection with the addition to the premises of the American Can Company, 535 Railway Street, the contract for installation of an elevator has been let to the Otis Fensom Company, New York, N. Y.

The general contract for the erection of an addition to the plant of the Begg Motor Company has been awarded to the Dominion Construction Company, 509 Richards Street. Approximate cost, $15,000.

Residences

Aylmer, Ont.
F. H. Kent and A. W. Pierce are each considering the erection of a residence on Talbot Street, to cost about $3,500.

C. M. Smith, Wellington Street, proposes to build five residences. Frame construction.

A. W. Pierce has had plans prepared for a residence to be built on Talbot Street, at an approximate cost of $7,000. Brick construction.

Bromptonville, Que.
Mrs. O. Lambert has decided to rebuild her residence, which was recently destroyed by fire. Approximate cost, $6,000.

Essex, Ont.
Work is about to start on the first of two frame residences to be built for John T. Rogers. Work will be supervised by owner.

Guelph, Ont.
W. H. Mahoney, Telephone Building, is receiving tenders on the erection of a residence for A. J. Frank, Oxford St. Stone and brick construction. Estimated cost, $3,500.

Hamilton, Ont.
W. Tomes, 22 High Park Avenue, is receiving tenders on the construction of twenty residences. Frame construction.

J. A. Armes, Federal Life Building, is preparing plans for a residence for T. S. Orr, Main Street, and will call for tenders shortly. Estimated cost, $12,000.

E. R. Bond, 652 Main Street E., has had plans prepared for two residences to be built on Cedar Avenue, at an approximate cost of $3,600. Brick and concrete construction.

Hullett Township, Ont.
Plans of a residence to cost about $3,200 are being prepared by John Brigham, Concession 12, Blyth. White brick construction.

Joseph Wheatley, Concession 13, Blyth, proposes to build a residence at an approximate cost of $3,000, and is preparing plans. White brick construction.

Kingston, Ont.
Isaac Allan, 98 Victoria Street, has commenced the erection of two residences, estimated to cost $5,000. Brick construction.

Listowel, Ont.
F. W. Hay, Main Street, has started work on a double residence, estimated to cost $4,000. Red pressed brick construction.

Work has been started by E. B. Smith on the erection of three brick residences on Main Street. Estimated cost, $7,500.

John Granger has commenced the erection of a residence on Inkerman Street, estimated to cost $3,000. Red pressed brick construction.

London, Ont.
H. C. McBridge, Edge Block, has plans in course of preparation for a double residence to cost about $6,000 and apartments estimated to cost $7,000.

Mitchell, Ont.
W. B. Barley intends to prepare plans for a residence to cost approximately $3,000.

F. C. Hord intends to prepare plans for a residence to cost about $3,000. Brick construction.

David Etty proposes to build a residence on Toronto Street, and will prepare plans. Approximate cost, $3,000.

Outremont, Que.
J. C. Perron, 722 Outremont Avenue,

intends to build residences on Querbes Avenue, at an approximate cost of $8,000. Brick and concrete construction.

Port Rowan, Ont.
Plans of a residence to cost about $3,000 will be prepared by W. P. Ferriss, Ellis Street.

Quebec, Que.
Plans of a residence are being prepared for E. Beaudoin, 256 Prince Edouard Street, and work will start early in May. Approximate cost, $6,000. Brick and concrete construction.

O. S. Laviolette has started work on a residence, estimated to cost $3,000. Brick and frame construction.

Leon Nadeau, 105 Franklin Street, has commenced the erection of a residence, estimated to cost $8,000. Brick and concrete construction.

D. Pare, 197 Third Avenue, propose to build a residence, at an approximate cost of $5,000, and will probably start work early next month. Brick and frame construction.

A. Faucher, 20 Joliette Street, has commenced the erection of a residence at St. Sauveur and Arage Streets. Brick and frame construction. Estimated cost, $3,000.

South Porcupine, Ont.
The Dome Mines, Limited, are preparing plans for about forty houses to accommodate their married workmen.

Toronto, Ont.
J. T. & H. Hutson, 43 Victoria Street, have commenced the erection of a residence at St. Andrews Gardens, and will let the smaller trades. Estimated cost, $6,000. Brick construction.

W. Moad, 46 Oakwood Avenue, has had plans prepared for duplex residences to be built on Oakwood Avenue, and will let smaller trades. Approximate cost, $5,000. Brick construction.

S. B. Green, 111 Evelyn Crescent, is building a residence on High Park Avenue, estimated to cost $3,500. Smaller trades will be let. Brick construction.

Work has been started by S. B. Green, 111 Evelyn Crescent, on the erection of a residence on High Park Avenue, estimated to cost $3,500. Brick construction. Smaller trades will be let.

P. L. Speirs, 95 Glenholme Avenue, is about to commence the erection of a duplex residence, estimated to cost $6,500. Smaller trades will be let. Brick construction.

Plans have been prepared for a residence to be built on Forest Hill Road by C. E. Tyler, 85 Cumberland Street. Contracts for smaller trades will be let about the end of next month. Approximate cost, $5,000.

Winterbourne, Ont.
Charles Goetz is about to start work on a residence, estimated to cost $3,000. White brick construction.

CONTRACTS AWARDED N N

Alderstot, Ont.
In connection with the erection of a residence on Ontario Street for F. W. Easterbrook, the contract for masonry has been let to T. Jones, 241 Prospect Street, Hamilton, and the carpentry to A. Coates & Son, Burlington.

Chatham, Ont.
The general contract for the erection of a residence for J. H. Burnie, 173 Adelaide Street S., has been awarded to Frank Sparks, Sandys Street, the painting to C. R. Guy, 8 Poplar Street, and the heating to the Watt Heating Company, King Street. Brick construction.

The general contract for the erection of a residence for Louis Palmer, Patteson Avenue, has been awarded to G. W. Rayment, 228 Thames Street, and the heating and plumbing to J. C. Wanless, King Street. Approximate cost, $4,500.

Grey Township, Ont.
The general contract for the erection of a residence for William Menary, Concession 9, has been let to Charles Seel, Cranbrook. White brick veneer construction. Approximate cost, $3,000.

Hamilton, Ont.
The general, carpentry and roofing contracts for the erection of two residences for Alexander Stewart, 615 Main Street E., have been awarded to E. H. Jones, 37 Senator Avenue. Estimated cost, $3,500.

Hebron, N.S.
Work is about to start on a residence for Knowles E. Crosby. General contractor, A. M. Knowlan, Hebron. Approximate cost, $4,000.

Hullett Township, Ont.
L. Hill, Blyth, has been awarded the contract for the erection of a residence for John Scott, Concession 10, Blyth. Frame and white brick construction. Estimated cost, $3,000.

Kinburn, Ont.
R. Groves has let the general contract for the erection of a residence to R. A. Kemp, 149 First Avenue, Ottawa. Frame and brick construction. Approximate cost, $11,000.

Listowel, Ont.
The general contract for the erection of a residence on Wallace Street for N. A. Gowdy has been awarded to N. Calder, and work will start shortly. Estimated cost, $3,000. Red brick construction.

Henry Karges has let the contract for the erection of two residences on Inkerman Street to W. H. McLachlan. Approximate cost, $4,000. Red pressed brick will be used.

The general contract for the erection of a residence for Ezra Reihm has been awarded to George Wahl. White brick construction. Approximate cost, $3,000.

Montreal, Que.
The general contract for alterations to a residence for the Ste. Elizabeth Society, 29 Seymour Avenue, has been let to R. Laberge, 141 onvent Street. Estimated cost, $5,000.

The general contract for the erection of a residence on Rosemount Street for the Trustees of St. Jean Berchmans has been awarded to T. Belanger, Valleyfield, Que., the heating, plumbing and roofing to T. Laturoelle & Son, Ltd., 6 Craig Street W., and the electrical work to J. A. St. Amour, 2171 St. Denis St. Estimated cost, $24,000.

Overbrook, Ont.
O. Jolcouer has commenced the erection of a residence at King and George Streets, and has let the electrical work to H. L. Allan, 373 Somerset Street. Approximate cost, $3,000.

Port Burwell, Ont.
The general contract for the erection of a residence for C. Sampson has been let to W. Morley, and work will start shortly. Frame and brick construction. Approximate cost, $3,000.

Quebec, Que.
P. N. Mathieu, Montmorency Village, has commenced the erection of a residence on First Avenue, Limoilou, for J. M. Dore, St. Gregoire De Montmorency. Brick and frame construction. Estimated cost, $3,000.

L. E. Labrecque, 128 Bridge Street, has let the general contract for the erection of a residence to G. Pare, 7 Laliberte Street. Brick and frame construction. Estimated cost, $5,000.

Sault Ste. Marie, Ont.
The contract for foundations and brick work required in the erection of a residence for R. T. Lane, 10 Queen Street, has been let to McLarty Brothers, and the carpentry to William Oben, Murray Street.

Toronto, Ont.
The following contracts have been let in connection with the residence being built for P. Morgan, 68 Bellefair Avenue:—masonry, H. A. Dancy & Son, Ltd., C. P. R. Building; carpentry, McMillan & Turner, 39 Huron Street; plumbing and heating, R. F. R. Maxwell & Company, 367 Queen Street W.; plastering, J. Robertson, 615 Lansdowne Avenue; painting, Taylor & Company, 9 Bloor Street E.; wiring, A. E. Paradine, 1987 Queen Street E.; roofing, W. E. Dillon Company, Limited, 183 George Street. Approximate cost, $9,000.

In connection with the erection of a residence for H. Fussell, 201 Howard Park Avenue, the contract for heating and plumbing has been awarded to Purdy, Mansell, Limited, 63 Albert Street, and sheet metal work to G. M. Bryan, 524 Yonge Street, and the wiring to R. A. L. Gray & Company, 85 York St.

Work has been started on the erection of a residence and garage for A. E. Whatmough, 491 Keele Street, and the contract for masonry let to Purton & Chennelle, 158 Ellsworth Avenue. Estimated cost, $3,500.

In connection with the residence being built on Jackman Avenue by J. T. Twigg, 28 First Avenue, the masonry has been awarded to William Bully, 119 Dinnick Crescent, and the carpentry to Kay Brothers. Approximate cost, $3,500.

Work has been started on the erection of a residence for J. H. Bone, 18 Toronto Street. General contractor, William Vokes, 228 Rusholme Road. Brick construction. Estimated cost $5,000.

Vancouver, B.C.
In connection with repairs to a store and apartments for Evans, Coleman & Evans, 407 Granville Street, the contract for roofing and sheet metal work has been let to Campbell & Grill, 331 Georgia Street E.; beams and tile work electrical work to the Jarvis Electric Company, 570 Richards Street, and the heating and plumbing to E. A. Bailey, 536 Helmcken Street.

Verdun, Que.
Anglins, Limited, 65 Victoria Street, Montreal, have commenced the erection

(Continued on page 50)

of a residence for J. Lyman, Willibrords Avenue. Estimated cost, $3,500. Brick construction.

Windsor, Ont.
The general contract for the erection of a residence for J. C. Pennington, La Belle Building, has been awarded to William Dupuis, 147 Dougal Avenue. Approximate cost, $5,000.

Power Plants, Electricity and Telephones

Goderich Township, Ont.
The Goderich Township Municipal Telephone Company propose to construct a line between Holmesville and Clinton, a distance of about four miles. Clerk, N. Trewartha, Holmesville.

Ottawa, Ont.
Tenders on the supply of ten knots of single conductor submarine cable will be received until 4 p.m., May 15th, by R. C. Desrochers, Department of Public Works, Ottawa. Specifications at office of the General Superintendent, Government Telegraph Service, Ottawa.

Regina, Sask.
D. C. McNab, Deputy Minister of Telephones, will receive tenders until noon, May 6th, on the supply of glass insulators, toppins, connecting sleeves, cross arms, galvanized iron and steel strand wire, pole line hardware and anchor rods. Specifications at the Department.

Truro, N.S.
The Town Council propose to purchase and remodel the Chalmers Electric Plant. Boilers, blowers, stacks, pumps, engines, generators and motors will be required.

Walkerton, Ont.
The Town Council intend to secure estimates on the installation of a power and lighting distribution system. Clerk, A. Collins.

Whitby, Ont.
Tenders on the installation of a fire alarm system will be received until May 1st, by Harry Watson, Chairman of Committee. Town Clerk, Joseph White.

CONTRACTS AWARDED

Kincora, Sask.
The contract for the construction of the Kincora Rural Telephone Company's system has been let to Brown & McKenzie, care of E. H. Joll, Kindersley, Sask. Cost, $12,040.

Fires

Brant Township, Ont.
Barns of Alexander McIntyre, Concession 9. Loss, $7,000. Will rebuild.

Broughdale, Ont.
Mill owned by Milton Sutherland. Loss, $6,000.

Charlesbourg, Que.
Stable and barn of C. T. Parent. Loss, $3,000. Will rebuild.

Fredericton, N.B.
Premises of Fredericton Steam Laundry and Smith Foundry Company. Loss, $5,000 each.

London, Ont.
Stables owned by F. Cline, 507 Queen's Avenue. Loss, $6,000. Will rebuild.

Mill Creek, B.C.
Chipping shed and drying kiln of the British Columbia Sulphite Fibre Company, Standard Bank Building, Vancouver. Loss, $40,000.

Port McNicoll, Ont.
Store of P. H. Beattie. Loss, $3,000.

St. Thomas, Ont.
Barns owned by J. B. Turner. Loss, $3,000.

Miscellaneous

Burlington, Ont.
The Town Council will receive tenders until May 13th on the supply of a combination chemical engine and hose truck. Clerk, J. S. Allen.

Hamilton, Ont.
The Board of Control will receive tenders until 5 p.m., May 8th, for the supply of mechanical rakes and appurtenances for the Gage Avenue pumping station. Engineer, A. F. Macallum.

Toronto, Ont.
The Board of Control will receive tenders until May 9th for the supply of two gasoline-driven diaphragm pumps. Specifications at Room 6, City Hall.

CONTRACTS AWARDED

Halifax, N.S.
The City Council have let the following contracts for supplies:—cast iron pipe, Drummond McCall & Company, 28 Victoria Square, Montreal; castings, Dartmouth Foundry Company, Maple Street, Dartmouth; lumber, Brookfield Brothers, Limited; cement, J. C. Calder, Central Whtrf; brick, Rhodes, Curry & Company, Windsor Street; drain pipe, E. F. Stevens, 16 Prince Street.

Kingston, Ont.
The City Council have awarded a contract for the supply of refined asphalt to the Aztec Oil & Asphalt Refining Company, 83 Craig Street, Montreal, at $26.31 per ton.

Montreal, Que.
The Harbor Commissioners have awarded the following contracts:—cement, Canada Cement Company, Ltd., Herald Building, Craig Street W., sand, Canada Sand & Gravel Company, Ltd., 486 William Street; broken stone, Rogers & Quirk, 1701 Iberville Avenue; rails and angle bars, Dominion Bridge Company, Ltd., Lachine.

Ottawa, Ont.
The Ontario Motor Car Company, 39 Queen Street, and the General Supply Company, Sparks Street, have each been awarded a contract for the supply of a flusher for the City Council. Prices, $7,150 and $7,800 respectively.

The Ottawa Improvement Commission have awarded the following contracts for supplies:—cement, Wright & Company, 25 Garneau Street, Hull; sand, Rideau Canal Supply Company, Canal Basin; lumber, McAuliffe Davis Lumber Company; hardware, McDougalls Ltd., Sussex Street.

Quebec, Que.
The City Council have let the following contracts for supplies:—stone, Quebec Brick Company, Quebec Railway Building; stone dust, J. J. Tierney, 204 Rorchester Street; lumber, J. H. Gignac & Son, 142 Church Street, N. Gignac, 68 La Lement Street, E. A. Hooks, 40 St. Francois Street, and O. S. Chalifour, Prince Edward Street.

Winnipeg, Man.
The City Council have awarded the contract for supply of the cast iron pipe to C. E. Chown, 147 Bannatyne Avenue.

Late News Items

Berlin, Ont.
Reitzel Brothers, Allan Street, have been awarded the contract for all work except heating, plumbing and electrical work required in the erection of a factory for the Onward Manufacturing Company, King Street W. Approximate cost, $10,000.

Hamilton, Ont.
The general, masonry and steel contracts for the erection of a block of stores and apartments for J. A. Morrow, 217 Caroline Street S., have been let to D. Tope, 191 Robinson Street. Approximate cost, $20,000.

Hull, Que.
The City Council will shortly call for tenders on the installation of a temporary plant for treating the water and will also have plans prepared for a permanent filtration plant, to cost approximately $200,000. Engineer, J. P. A. Laforest.

Kenogami, Que.
Price Brothers & Company, Limited, 56 St. Peter Street, Quebec, are considering extensions to their lumber mills, to cost about $200,000. Architect, A. Whipple. Concrete construction is probable.

The Town Council are having plans prepared for a Town Hall, estimated to cost $10,000. Architects, Syndicate des Engineers des Saguenay, Chicoutimi. Steel and brick construction.

Quebec, Que.
J. Lafrance, 21 Plessis Street, has commenced the erection of a residence, estimated to cost $8,000. Brick and concrete construction.

The Quebec Harbor Commissioners, Pointe-a-Carey Wharf, have let the general contract for the erection of a freight shed and grain galleries to J. Gosselin, 96 St. George Street, Levis.

The contract for the erection of a residence on Cartier Street for H. M. Cote, 631 St. John Street, to G. Cantin, 22 Lee Street. Approximate cost, $18,000. Brick construction.

The general, masonry and carpentry contracts for the erection of a factory on Ste. Helene Street for the Dominion Corset Manufacturing Company has been awarded to M. Cauchon, 307 Richardson Street. Brick and stone construction. Approximate cost, $50,000.

Radison, Sask.
R. M. Thompson, Masonic Temple, Saskatoon, is preparing plans of a school estimated to cost $14,000. Brick and concrete construction.

Sherbrooke, Que.
Ths Catholic Board of School Commissioners are having plans prepared for an addition to the school on First Avenue, to cost about $15,000. Brick and stone construction. Architect, J. W. Gregoire, 119a Wellington Street.

Toronto, Ont.
G. Ferrier, 302 Danforth Avenue, is receiving tenders on the erection of a garage, estimated to cost $6,500. Steel and brick construction.

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Vol. 30 **May 3, 1916** **No. 18**

Principal Contents

Liability After Number of Years

An unusually interesting legal case is just now receiving prominence in Montreal, which concerns the liability of the contractor and architect for too rapid deterioration of materials used in the construction of a building. In this instance it is a case of dry-rot setting in in the timbers used in a spool thread factory and the owners have sued the contractors, Peter Lyall & Sons, and the architects, Brown & Vallance, for recovery of the cost of replacing the defective timbers with steel.

Brown and Vallance drew plans for this company in 1907 and they were submitted (by authority of the plaintiffs) to J. & P. Coates, an English firm, and received their approval. The work was begun in 1908 by the Lyall company. It appears that complaint of the construction work was made soon after the factory was occupied and the defendants in the case were asked to remedy the defects. Following their failure to do this the plaintiffs (The Canadian Spool Cotton Company) themselves ripped out the rotted wood and replaced it with steel at a cost of some $90,000. The Superior Court has already awarded $71,000 to the plaintiffs and it is against this judgment that the argument is now made before the Court of Review.

The contractors, as we read the evidence, argue that the timber used was according to specifications. For the architects it is maintained that the submission of the plans to the English firm removes responsibility from their shoulders, and that in any case neither they nor the contractors can be held liable for the cost of replacing the defective wood timbers with steel. It appears that the architects at one time offered $5,000 to settle the matter without litigation. This may be taken by the Court as evidence of their acknowledgement of liability. The judgment is awaited as we go to press, but whatever the immediate outcome, it looks like a question for the Privy Council.

In this same connection we ask the attention of our readers to a paper reproduced in this issue of the Contract Record read by Mr. Geo. H. Montgomery, K.C., of Montreal, before the Canadian Society of Civil Engineers. This paper is particularly interesting, especially at this time, to architects, engineers and contractors, in that one of the points discussed very fully is the liability to damage for a period of years after a building or engineering work has been completed.

The Load of Vehicles Act—Ontario

In 1915 Mr. Geo. S. Henry, M.L.A., for East York, introduced a bill in the Ontario Legislature which had for its purpose regulating and limiting the load vehicles might carry on highways. At that session of the Legislature the matter was discussed and allowed to stand over for one year. At the 1916 session of the Legislature Mr. Henry re-introduced the bill, and after it was referred to a sub-committee of the Municipal Committee, fully discussed and amended, it was given its third reading and is now law.

A number of the States of Union as well as certain European countries have adopted similar measures, but Ontario is the first of the Canadian Provinces to make it a Provincial measure.

In the early days of the Good Roads movement, an attempt was made to increase the width of tire and in this way limit the load per inch, but because of the large investment in narrow tired vehicles regulations of that character seemed impossible.

Then followed the motor truck with its four or five ton load, and the new conditions that were created each succeeding year as the weight and size of the trucks increased were leading to hopeless confusion had not Mr. Henry been successful in pressing this measure on the Statute books. In brief the terms of the bill are:

(1) No vehicle shall carry upon the highway a load, including the vehicle, greater than 12 tons or more than $4\frac{1}{2}$ tons on any one wheel.

(2) No vehicle shall carry a load, including the

vehicle, which will impose a greater weight than 650 lbs. per inch of tire on the highway.

(3) No vehicle shall have a greater width than 90 inches except traction engines, which are limited to 110 ins.

(4) The traction engine act is amended in so far as it conflicts with this act.

With this measure to act as a guide, Engineers will be in a better position than heretofore to work out economical designs for bridges, pavements and roadways.

A Few Plastering Hints

Builders often wonder why shrinkage checks and cracks appear in wall plaster. There are different reasons that might be given for this—plasterers are sometimes guilty of making their plastering mixtures too rich, the old guessed-at proportion of three of sand to one of lime or cement is quite unnecessary with the high grade mixtures that are in use today. Five or six or even seven to one gives a density which dries out more perfectly and causes no shrinkage after setting has taken place. The old proportion, being too rich, causes shrinkage cracks which admit moisture, which, on the action of frost, enlarges the checks and destroys the work. Even when there is no weather exposure, moisture and variation in temperature will soon enlarge small checks to unsightly proportions.

Another cause of checking or cracking is the lath, which may affect the plaster in several ways. If the lath is too dry when the plaster is applied, it absorbs water which, together with that which evaporates in dry weather, does not leave sufficient moisture for crystallization. This may be overcome by dampening the lath before commencing to plaster, enclosing the room to reduce the ventilation, so that evaporation will not take place so rapidly. A great deal of trouble in plastering is due to lath expending or buckling by the additional moisture from the plaster. This is overcome by proper nailing of the lath, leaving a space between the ends to allow for expansion and securely nailing to intermediate studding. Also the lath, for best results, should be uniformly spaced and of uniformly graded wood. Green lath, or lath with bark on, should never be used along side of lath properly seasoned.

Lathing and improper mixing are the causes of most difficulties seen in hard wall plaster. Use a little more care in the selection and nailing of the lath—a trade which too many men nowadays try to see how quickly can be done, rather than how well it can be done. Also use leaner mixtures and most of these difficulties can be done away with.

Revival in Brick

Florida these days is "eating brick." The building of brick roads has been given a strong impetus during the past year by the introduction of new constructional methods which make for durability. In Volusia county recently a contract was let to the Southern Clay Manufacturing Company of Chattanooga, Tennessee for 200,000 yards of 3½-inch wire-cut lug brick pavement, in the DelandLake Helen district, the brick to be laid on edge on a natural soil foundation and grouted. This road will be about 26 miles long, and nine feet wide except in Deland. In the latter place the roadway will be paved 50 feet wide. Many miles of this type of road were constructed in Orange county in 1915, and a large amount of yardage will be built in other sections during the current calendar year.

Canadian Research Bureau

The Canadian Research Bureau has been established, under a Dominion charter, to carry out research work in connection with the country's natural resources, including mineral, metal, hydro-electric and chemical branches. The Bureau has been established by the C. P. R. with the object of applying the results of the researches to Canadian industries; it is hoped to utilise many products now wasted, and to enable additional industries to be founded. The Canadian Pacific Railway aims to secure the mobilization of the ablest scientists and chemists of Canada, and to associate them with a central organization, to direct the activities of the scientists and experts engaged in research work in all parts of the Dominion. The discoveries and information gleaned by the central organization will be disseminated from time to time by bulletins. Mr. Arthur D. Little has been appointed to establish this central organization at Montreal. He is a past president of the American Chemical Society, a member of the Institute of Chemical Engineers, and a director of the Chemical and Engineer Department of the Institute of Technology. He is asking for the co-operation of scientists and chemists now engaged in research work.

Progress on Victoria Breakwater

The large work of constructing the reinforced concrete breakwater at Victoria is now well under way. Although no new records were established during last month, steady progress was maintained according to statistics compiled by the supervising engineers. Now, that the weather conditions are more settled, the contractors are satisfied that the work will proceed at a more rapid rate than has been the case during the winter months.

For the greater part of its entire length, the breakwater looms up well above the water-line, presenting a solid buttress of stone and concrete for over two-thirds of its length to seaward. The contractors are now concentrating operations at the extreme shoulder of the main arm, where divers are engaged in placing the huge granite blocks and levelling off the foundations at the commencement of the extreme arm of the seawall. As the work proceeds the operations are necessarily carried on at a lower level. Thousands of tons of coarse rubble continue to be deposited to form the foundations of the extreme arm, and as it reaches the desired level it is surfaced off for the reception of the granite.

It is interesting to note that since the contract was started no less than 1,082,800 tons of rubble has been dumped for the breakwater foundations. This tremendous amount of foundation includes 242,000 tons of what is technically known as "core."

There has also been placed to date a total of 108,900 tons of granite blocks, while 23,900 cubic yards of concrete, forming the superstructure, have been poured.

During last month, 22,300 tons of rubble were dumped; 7,700 tons of granite blocks were set in place and 1,700 cubic yards of concrete poured, making five blocks.—Rock Products.

The Might Directories, in their review of 1915, estimate the population of Toronto to be 544,456. The city contains 100,825 buildings of all varieties, situated on some 1,740 streets.

Shall I Build Now or Wait? Comparative Prices Today and at Outbreak of War

(Concluded)

Paints and Varnishes

CONSIDERABLE advance is noted in the price of most of the ingredients from which paints are made. Linseed oil today is selling at about $1.00 per gallon, as compared with 53c in the Fall of 1914; red lead has increased from 5c to 10c; zinc white, from 7c to 30c; lithophone, from 5c to 16c; pure white lead in oil, from $8.40 to $11.85. Red oxide of iron and graphite paint, frequently specified by engineers, has increased only about 40c per gallon, as the pigment is produced in this country. The advance on high grade liquid paint figures out at an increase of about 45c a gallon, while the advance on high grade white paint in liquid form, on account of high cost of metals, has been about 60c a gallon.

So far as varnishes are concerned, there has been comparatively little advance, but owing to the higher cost of the gums and linseed oil used in their manufacture, it is stated that an all-round advance is coming.

We are indebted for the above figures to the Canada Paint Co. The International Varnish Co. advise us that, excepting for limited lines into which various ingredients enter which have previously been secured from Germany, the varnish prices are the same as at the outbreak of war.

Fire-proofing Material

There does not appear to have been any appreciable increase in the cost of fire-proofing material. The National Fire-proofing Co. advise that prices are approximately the same as before the war broke out. Whether there will be an increase in the immediate future depends largely on the demand, the cost of fuel, and the difficulty of obtaining labor.

Glass

The following information, for which we are indebted to Mr. Edwin Hill of the Toronto Plate Glass Importing Co., sums up the glass situation.

The conditions in the glass market are abnormal, and may be said to be acute, from the jobbers point of view, as it is difficult to get supplies of glass at all. The immediate cause of the shortage is the great revival of building in the U. S. A. 1914 with the U. S. A., as with us, was a declining year, and when war was declared, the building trade simply died. This circumstance gave the Canadian glass importers some relief in getting supplies which were cut off from Europe. In the U. S. A. the domestic demand had fallen off so heavily that it scarcely absorbed 50 per cent. of their production. In plate glass, 1915 opened for U. S. A. manufacturers with scarcely an order in sight, and prices declined 25 per cent. or more. The larger works pressed hard to secure export business in Great Britain and her colonies, and towards the end of 1915 good orders were received, because Belgium, the great supplier of plate glass, is under control of the Germans.

The stagnant condition caused three large U. S. A. plate glass works to close indefinitely, due to ruinous price cutting. However, November 1915 saw a remarkable change, as, with the three works closed and the export business taking one-third of the production of the U. S. A. factories, the largest American jobbers began to lay in stocks for fear of being left without glass. The 1916 revival of United States building, however, has resulted in these jobbers being over-sold. It is thus evident why the Canadian jobber finds it difficult to get glass at all.

August 25, 1915, saw the lowest price plate glass was ever sold at in the United States. On November 1, 1915, prices advanced 10 per cent., on December 20, 1915, another 10 per cent., on February 1, 1916, another 35 per cent., and other advances are pending. As noted already, however, it is not the cost the Canadian jobber has to contend with so much as the shortage of supply.

The sheet glass (common window glass) situation is not quite so acute, but generally speaking, the same factors have entered into it, only in a more modified form. Glass is now coming into Canada bought at 85 per cent. increase on 1914 prices, and further advances are expected.

The Luxfer Prism Co. advise that they are getting a number of their own lines at the same prices as when war started. The demand has been small and they have been supplied through advance contracts. Regarding such lines of window glass as they use for leaded and steel windows, they figure the cost, including war tax, has advanced from 30 to 35 per cent. Manufacturers, however, generally have withdrawn their prices, as they are subject to continual advance.

Beaver-Board

As many houses and offices are now trimming in beaver board, this is becoming a more important factor in the total cost. There has apparently been no change in the price of this material; so the Beaver Board Companies advise us. They state that the price of raw material has gone up from 50c to $1.00 a thousand square feet, but that no increase in the finished product has been made, as they have felt it would be better to absorb the additional cost themselves, during the present period of stress, than to ask the consumer to carry it. The beaver board business in Canada is growing rapidly, and, so far, this year shows a big increase over 1915.

Steel

The price of steel today, as compared with a year ago, depends to a considerable extent on how soon the material is wanted and whether or not the fabricator is covered by a contract with the mills, made several months ago, covering present specifications. There is also a considerable variance in the price of steel, depending on the sections required, and we do not believe that an authoratative statement can be made as to the exact increase. On some items, wanted quickly, the plain material may run from 50 per cent. to 100 per cent. higher than a year ago, but as the fabricating shops are not busy, the actual cost, to the consumer, of delivered steel work would be increased only by the increased cost of the raw material, which might be anywhere from 15 per cent. to 30 per cent. The item of steel is, of course, a negligible one in residence construction.

Electric Wiring

The cost of electric wiring has been affected most by the increased cost in copper, but practically everything else that is used in the wiring of a building has been increased in price—switches, plates, screws, and so on. Copper wiring has increased, depending on the class of wire, anywhere from 60 per cent. to 100 per cent. At a rough estimate, the wiring of a building would cost from 30 per cent. to 35 per cent. more than at the outbreak of the war.

Summary

Summed up, therefore, the whole situation with regard to building appears to be about as follows:—

Stone and sand—price somewhat easier.

Brick—fully 25 per cent. drop.

Cement—reduction of 10c to 15c a barrel.

Lime—no change.

Lumber and mill work—no change or slight advance, still considerably lower than 1912 and 1913.

Hard wall plaster—no advance.

Plumbing and heating—a considerable advance on account of higher metal prices.

Fire-proof doors, windows, sash, etc.—a considerable advance.

Papers and felts—big advances in spots, especially dye materials.

Metallic roofing—increase of 10 per cent. to 25 per cent.

Paints—increase varies.

Fireproofing materials—no increase.

Glass—increase of 50 per cent. to 60 per cent. and hard to get.

Varnishes—about the same.

Beaver board—no advance.

Steel—15 per cent. to 30 per cent. increase.

Electric wiring—35 per cent. increase.

Some Figures on the First Year's Operation of the Ontario Workmen's Compensation Act

After a year's operation the Ontario Workmen's Compensation Act, according to the annual report just issued, has fully justified its existence. It is intimated that under the present Act the relations between employer and employee have become more amicable, and as a result great benefits have been derived from the new legislation. Under the old arrangement where a workman had to sue and prove negligence on the part of the employer, (which he was often not able to do immediately on account of his physical disability), only a small proportion of accidents were dealt with and many judgments that might reasonably have gone in favor of the workman were never made. Under the present system, however, where all accidents have to be reported to headquarters within three days, compensation is given in many cases without delay and even though the workman may be at the time so far disabled as to know nothing of it. This is as it should be, because if an injured workman is to get compensation at all, the first few days, or weeks, is just the time he usually will need aid most.

Accidents in 1915

The report shows that up to December 31, 17,033 notices of accidents had been received and only 1,117 remained unadjusted at the close of the year. The assessments collected during the year 1915 amounted to $1,539,492.40, of which $1,186,221.62 was distributed or set aside for accidents. A net balance or surplus of $395,026.40 was left part of which will be remitted to employers in the form of lowered rates for the coming year.

The total number of accidents for which compensation was made was 9,829. Of these there were 8,544 cases of temporary disability, 1,034 of permanent, and 251 deaths. The largest number of accidents occurred from falling, rolling, and flying objects, namely, 2,587; the next from machinery and parts, 2,098; third, from falls, 1,100; fourth, dangerous substances, such as electric currents, 623; moving vehicles, 270; hoisting apparatus, 208; runaways and animals, 78. Out of these 773 cases developed blood-poisoning, of which four caused death and 11 amputation. There were 170,711 days lost, equivalent to 569 men's labor for one year.

The amount paid by the board for injuries and disablements required on an average 150 cheques daily, amounting to $3,600.

Where Accidents Occurred

There were 14,750 employers in Schedule 1 contributing to the Accident Fund, but not individually liable. For Schedule 2 there were 1,252 employers liable for payment of compensation fixed by the board, but not contributing to the Accident Fund. These included such bodies as railways and municipalities. There were also Crown cases, including the Timiskaming and Northern Ontario Railway and the Hydro-Electric Power Commission, who voluntarily placed themselves under the operation of the board.

The figures show that the average wage of those injured was $13.27 a week, the average age being 33 years, running between 81 years, the oldest, and 11, the youngest.

The largest number of cases reported were from York County, 1,868; Wentworth County, in which Hamilton is located, was second, with 919; Algoma, in which the big salt works are located, was third, with 473; while Sudbury, with the copper mines, was fourth, with 468. No payments are made except where the injury disables a man for at least seven days.

New Act Satisfactory

The act in general seems to be very popular. The workmen's attitude towards it needs no mention. The general attitude of the employers is indicated by the request of a large number who are not liable under the present provision for assessment or payment of compensation, who have expressed the desire to come under the terms of the act. According to the report, the act has been working smoothly and satisfactorily, and the many benefits seem to be generally recognized and appreciated by the employers and the workmen.

Reports have been made promptly and claims, for the most part, disposed of expeditiously. The old annoyance of litigation between employee and employer in case of accident has been removed, and the intricacies and hardships upon the workmen and their families of the old system of negligence, common employment and assumed risk, have been eliminated. Legal fees of any sort have been done away with. The act has increased the percentage of cases where compensation has been granted for injuries, and the number of dependents benefited is one of the most gratifying features of the report.

New Administration Building of the Hydro-Electric Power Commission of Ontario

OWING to the rapid increase of the business, and therefore of the staff requirements of the Hydro-electric Power Commission of Ontario, it was found that the old quarters in the Continental Life Building were too congested, and the board of directors decided in 1914 to erect a new office building. After various sites had been examined and considered, it was finally decided to build on University Ave. on part of the old Caer Howell property. The building is situated just below College St., with the main facade facing on University Avenue directly opposite the General Hospital. The architecture is simple classic, Greek design; front elevation, cut stone, with side and rear walls, brown pressed faced brick, cut stone window caps and sills. The feature of the main facade in an artistic portico with an arched roof, with a cast stone plate bearing the commission's name. Surmounting the portico are four large Ionic columns flanked by end pavilions, supporting an extended stone coping, the whole supporting the top or sixth storey.

Immediately under the portico the main entrance is situated, with the main double doors of solid bronze. The main entrance hall has a floor of white Renfrew marble with a dado of Bancroft white marble. All doors off this main entrance are solid bronze. An enquiry desk is placed in the main hall, off which are located the stairways and elevators, situated in interior bays.

Basement

The heating is by the forced hot water system, two large Spencer heaters supplying hot water to a tank directly over the heaters, which are automatic feeders burning buckwheat coal. Hot water is forced up throughout the building by two centrifugal pumps, operating one at a time or both in parallel, driven by two 2 h.p., 220 volts, 3 phase, 25 cycle, motors. Fuel room for the heaters is underground outside the building, and has a capacity for one car load of coal. There is a steel stack on the west side of the building in connection with the heaters.

There is also in the basement a private and a main

Fig. 1.—New Administration Building of the Hydro Electric Power Commission, University Avenue, Toronto.

dining room where lunch will be served for the employees; these rooms are separated by three large sliding doors which may be opened out for banquet purposes. There is also a large sitting-room adjacent to the dining room, and the necessary kitchen, which will be electrically fitted and operated, besides the pantry and refrigerator. Filing and stationery storage rooms, and a large vault room, take up the remaining basement floor space.

First Floor

The first floor, with the exception of the toilet and the switch board booth, is used entirely by the Accounting and Filing departments. The accounting department occupy two large rooms to the right and left of the main entrance, and the filing department occupy the rooms in the rear of the building. The files are steel, five files high single, ten double, set in rows of eighty. Files may be despatched to any floor by means of an automatic dumb waiter.

Second Floor

The second or executive floor contains the Board Room on the north west corner with a private office connected for the use of the Commissioners, Chairman's office and committee room connected to the Board Room by a private passageway, Chief Engineer's and Secretary's offices, and also a library and conference room. This floor throughout is finished in mahogany-finish, hollow steel doors and trim, with court linoleum, cemented directly to the concrete, in the main corridors and hall-ways. The Board Room is finished with oak wall panelling, real mahogany dados, oak floors, and beamed ceiling. Chairman's and Commissioners' rooms are finished in real mahogany with oak floors.

Upper Floors

The upper floors, which are all very similar in floor plan, contain the Municipal, Purchasing, Operating, Railway, Hydraulic, Station Equipment and Building, Line Construction, other departmental offices and drafting rooms, all arranged for maximum efficiency. These floors are finished in Circassion walnut-finish, hollow steel doors and trim. All floors with the exception of the ground floor have a drinking fountain at the head of the stairs.

Foundations

A great deal of difficulty was encountered with the foundations, part of the site being on artificial fill over an old ravine which ran diagonally across the lot. Below this ravine quick sand was encountered, which made it essential to sink the foundations to bed rock some sixty feet below ground level. The building stands on twenty-eight re-inforced concrete cassions, fifty feet high, sunk to bed rock—twenty-four cassions being 3 ft. 6 in. in diameter, and four, 6 ft. in diameter. The space between the piers is filled in with a reinforced web or wall which acts as a beam to support the walls of the building. Building was delayed materially owing to the difficulty with the foundations.

Construction is fire-proof, steel and re-inforced con-

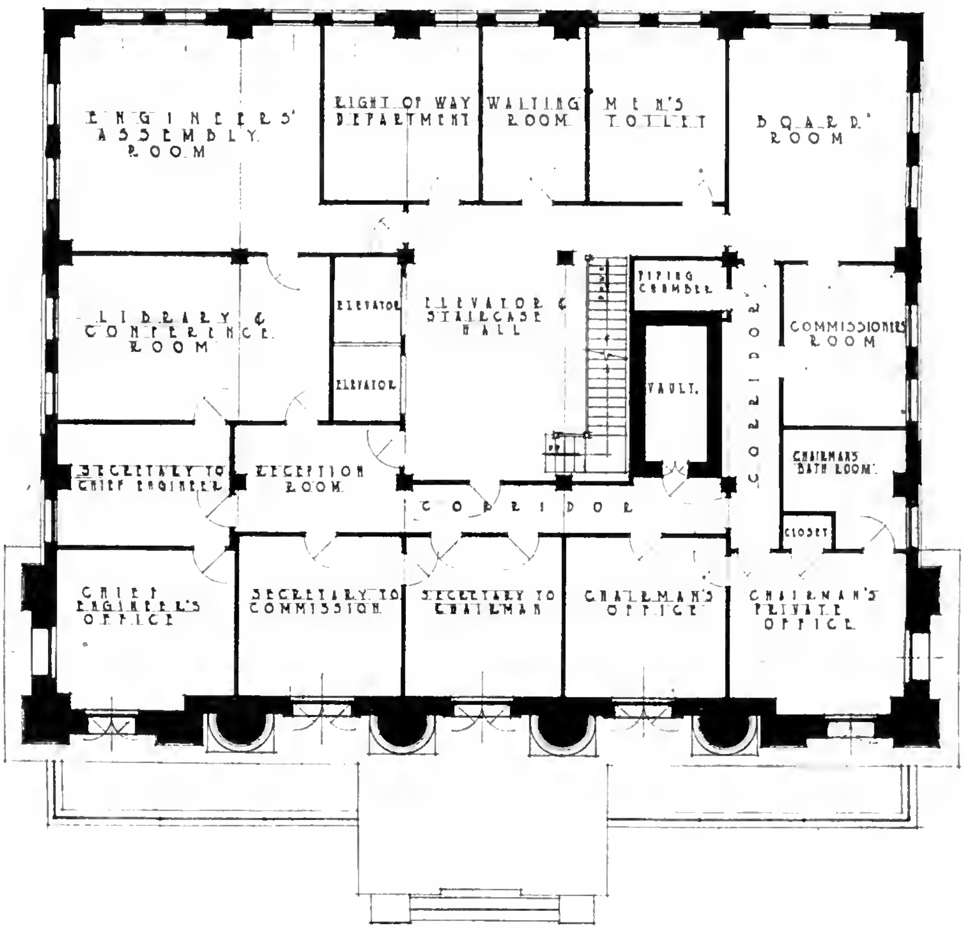


Fig. 2.—Plan of the second or executive floor—Administration Building.

crete, hollow tile floors and walls, steel stairs with mastic treads, court linoleum in corridors, oak floors in office rooms. All doors and trim are steel, in mahogany or walnut finish, windows are leaded glass with steel frames, walls are rough hard wall plaster, with picture moulding. A fire escape corridor from each central hall on each floor leads to steel fire escapes at the rear of the building.

Electrical Equipment

Electric power for lighting and power in the building is furnished by the Toronto Hydro-Electric System at 2,300 volts, which voltage is reduced to 230 and 115 by transformers in the transformer room. This room is a cement underground building on the north west corner of the larger building, and opens into the boiler and switch board room in the basement. There are three 30 kw. 2,200/230 v. Crocker Wheeler transformers for power, and two 20 kw. 2200/100 v. transformers for lighting, besides these are the storage batteries for the lighting and telephone systems.

From the transformer room cables are led underground through conduit to the switch board in the north end of the basement, which consists of two 18

Fig. 3.—Hollow tile floor and partition construction.

in. panels 8 ft. high, and 2 panels 24 in. wide, 8 ft. high, black slate. The board contains a high tension volt meter, 3,000 volts, a 400 kw. watt hour demand meter, two ampere meters, one for the total load and the other connected to measure the load on any circuit by simply plugging in the circuit to be read; two oil breakers and four, single phase, overload relays, complete the equipment on this half of the board. The other half contains the switches for the different circuits—elevators, vacuum, pumps, lights, dumb waiter, blueprint, etc. The switchboard equipment is Canadian Westinghouse.

A vacuum cleaning system, pump operated by 3 h.p. C.G.E. induction motor, has three outlets on each floor, the system is automatically controlled from all floors and may be started from any place in the building at the will of the operator, simply by pressing the button beside the outlet, which closes the switch on the switch board and starts the motor. There are two bronze elevators, electrically lighted, driven by two 25 cycle motors.

A novel system about the building is the automatic dumb waiter. This waiter runs in a flue, back and west of the main halls, which contains all cables, wires, pipes and plumbing outlets of the different floors. The waiter is automatically controlled from the ground floor by push buttons. On the request for files from any floor, they are put on the elevator and despatched simply by pushing the button corresponding to the floor. The elevator goes up to the desired floor, stops and turns on a bulls-eye light in the door. Opening any door on intervening floors automatically stops the elevator at that floor and thus prevents accidents.

Lighting Fixtures

Lighting outlets are lavishly installed through the whole building. Halls and corridors have semi-translucent, completely closed in, shades, while offices have semi-indirect lighting. The Board Room has an elaborate, bronze, candlestick chandelier. Every office is equipped with four base board receptacles for electrical appliances. All dark rooms are automatically lighted on opening the doors.

Telephone and Signal System

There is an automatic telephone system with a switch board in the boiler and switch board room in the basement. This system operates in connection with the company's private lines over the distributing system and the private lines to the store house and stock room, and also with the Bell system. The connection between the different lines is made in the telephone booth on the main floor. Telephones and signal systems are wired in all offices. Beside the dumb waiter is a telephone box on each floor from which cables lead to every room, so that at the least notice a telephone or a signal system between any two rooms may be connected without any interference to the office fittings.

Contractors

In placing contracts the Commission endeavored to use, where suitable, material manufactured in Canada, and, where possible, by Hydro power. The General Contractors were Witchall & Son, who covered excavation, concrete, brick and stone masonry, structural steel work, floors, interior partitions, in short, the structural portions of the building. The following are some of the sub-contractors of G. C. Witchall & Son, who use Hydro power in the production of material supplied by them:—pressed brick, Inter-Provincial Brick Co., Cheltenham; cement, St. Marys Portland Cement Co., St. Marys; cut stone work, Witchall & Son, Toronto; gypsum partition blocks, Ebsary Co., Caledonia; paint, Dominion Paint Works, Walkerville.

Other contracts which were placed direct by the Commission with contractors using Hydro power are as follows:—sash and casement, Trussed Concrete Steel Co., Walkerville; plastering, R. C. Dancy, Toronto; marble work, Canada Glass, Mantels & Tile Co., Toronto; hollow steel doors and trim, A. B. Ormsby Co., Toronto; elevators and dumb waiter, Otis-Fensom Elevator Co., Toronto; radiators, Steel & Radiation, Ltd., Toronto; iron valves, Canadian Fairbanks-Morse, Toronto; pumps, Canadian Buffalo Forge, Berlin; door hardware, Aikenhead Hardware Co. (Canadian Yale and Towne).

Some of the other contracts placed by the Commission were:—fire escapes, Dominion Ornamental Iron Co.; bronze work, Architectural Bronze & Iron Works; boilers, Waldon Heating Co.; switchboard, Canadian Westinghouse Co.; automatic Presto telephone switch board, Canadian Independent Telephone Co., Toronto; piping G. E. B. Grinyer; plumbing system, Keiths, Ltd.; plumbing fixtures, Imperial Products; smokestack, Toronto Iron Works; glazing, Toronto Plate Glass Co.

The Law and the Engineer and Architect

The Interpretation of Modern Specifications with Respect to the Relations Between Proprietor, Engineer and Architect

By Geo. H. Montgomery, K. C.*

To anyone familiar with the wording of the modern specification as drawn by the modern engineer, a paper upon the law and the engineer would seem superfluous, since the engineer would seem to be made a law unto himself, the decision of the engineer or the architect, as the case may be, being declared to be final in every second paragraph of the specification. However, the law has jealously guarded its prerogatives, and there is possibly no branch of our jurisprudence more complex than that surrounding the functions of the architect and engineer. In the province of Quebec this is particularly the case, since we are operating under a mixed system of law, French and English being cited and applied almost indiscriminately, with the result that varying as they do in their basic principles we are faced with a mass of conflicting jurisprudence, making the task of counsel who are called upon to advise, rather a difficult one. This is especially so in the branch relating to the responsibility of the architect or engineer for the stability of the work entrusted to him, as well as in that relating to the necessity, effect and finality of his certificate. In grouping the architect and engineer together I do so advisedly, as their duties and responsibilities are so analogous that the jurisprudence that has grown up can be applied to one or the other indiscriminately. So much so is this the case that it has been expressly held that the somewhat stringent and exceptional provisions which exist both in our own Code and in the Code Napoleon regarding the responsibility of architects, apply equally to engineers, notwithstanding the fact that in the application of these articles in every other respect they have been treated as exceptional provisions not to be extended beyond their literal terms.

Engineer's Ambiguous Position

Occupying as the engineer does a somewhat ambiguous position, in that he is called upon in practically every contract to act as agent and representative of the proprietor as against the contractor, and at the same time to act in a quasi-judicial position between the contractor and the proprietor, he must find his position an embarrassing one, and it is to the credit of the engineering profession that the resultant litigation of disputes is not even more frequent than it is found to be in practice. It must be admitted that the law has not done much to relieve him of his embarrassment, since as towards the proprietor, the party by whom he is employed, it calls upon him to exercise all the care and zeal which can be expected from one who is employed only in the interests of the proprietor, and at the same time severely criticizes him if he acts in other than an impartial manner as between the proprietor and the contractor whenever by the terms of the contract matters are referred to him for decision. Mr. Gregory, who was both a lawyer and an engineer, has attempted to reconcile his position in the following terms:—

"In accepting an appointment from the employer, the engineer or architect undertakes responsibilities to the employer under the contract, but to the contractor only under the law. To the employer he may be liable for an error in the performance of his duties; but to the contractor only for a fraud committed or aided by him, in the performance of his functions under the contract, or otherwise."

"As fraud and deceit are mala in se, and in the performance of functions under the provisions of a contract, as in every other transaction, a person is under the legal obligation to be a party to no fraud, and to make no false statement for the purpose of it being used to another's injury, the employer's direction or request to the engineer or architect as to the performance of his duties under a contract is no justification for a fraudulent performance of them."

"That his functions shall not be exercised in bad faith, is the extent of the engineer or architect's obligation to the contractor with whom he has no privity of contract; while to the employer, he may be under the obligation to duly perform all the duties which, by his acceptance of the appointment, he undertook to perform."

"Such disparity between the responsibility which the engineer or architect has to the contractor and that which he has to the employer, must necessarily exist where he is the agent, appointed solely by the employer, to exercise a control over a contractor who has no part in his appointment."

As a corollary to the proposition that no contractual relation exists or can exist except with the proprietor, and not with the contractor, it follows that the architect or engineer cannot be employed in the interests of both, or receive fees from both.

Quoad the Proprietor

In his relations with the proprietor we have to consider, first, the extent of his mandate and how far he can bind the proprietor. In this respect reference, of course, must first be made to the terms of the particular contract, but as a general proposition it can be laid down that while he is the agent of the proprietor he has only the power to bind him within the strict limits of his mandate, as it has been held that with regard to drawings and plans he has no implied authority to warrant they are correct, or that the work can be carried out in accordance with them, or that temporary constructional works, in the case of engineering contracts, are practicable. Again, the authority of the architect or engineer as agent does not empower him, without the knowledge or consent of his employer, to make promises that the conditions contained in it will be followed or waived, or, if there are omissions in the drawings, plans or specifications, to order as extras such things omitted as are necessary to complete the contract, or where the scheme is impracticable, to order as an extra work which is necessary to enable the works to be constructed. It is laid down as a principle that the architect or engineer has no general authority to vary, waive or dispense with any of the conditions contained in the contract without being specially authorized to do so, and even where he is authorized by the contract to give directions as

* Before C. S. C. E., Montreal.

to the manner in which the contract is to be carried out, he can only give such directions as fall within the contract, and may not vary the whole scheme of the proposed works, or allow the substitution of entirely different materials for those specified in the contract. Again, an architect or engineer has authority to order extras only when the contract so provides, and then only to the extent provided therein. He cannot waive or dispense with a condition that extras shall be ordered in writing, or any similar condition. It is to be noted, however, that if he has power by a final and conclusive certificate to adjust the amount payable by the employer to the contractor, the employer must pay the amount certified for if the certificate is honestly given, although it may include extras not ordered in the manner prescribed in the contract.

Engineer's Relation to the Proprietor

As regards his duties and responsibilities towards the proprietor, they differ somewhat, as far as responsibilities are concerned, in this province, from the law which obtains in the provinces which are under the common law. Under the common law system architects and engineers are only required to exercise reasonable skill and diligence. As to the amount of skill required, the architect or engineer need not exercise an extraordinary degree of skill. It is not enough to make him responsible, that others of far greater experience or ability might have used a greater degree of skill, or even that he might have used some greater degree; the questions is whether there has been such a want of competent care and skill leading to the bad result as to amount to negligence. He is bound, however, to acquaint himself with the requirements of all public and local statutes, as well as to exercise reasonable precaution in the examination of the site on which the works are to be constructed. The mere approval of the plans and specifications by the employer will not exonerate the architect or engineer from liability when the design of the works is structurally defective, or does not carry out the instructions of the employer, although the employer has been told by the architect or engineer to examine them.

Responsibility of the Engineer

Under the civil law system in force in this province, the responsibility of the architect or engineer is more extensive. A presumption of fault is cast upon him and he is responsible jointly and severally with the contractor for the failure of the structure without evidence of special negligence.

(Articles 1688 and 1689, Civil Code)

"1688. If a building perish in whole or in part within ten years, from defect in construction, or even from the unfavorable nature of the ground, the architect superintending the work, and the builder are jointly and severally liable for the loss."

"1689. If, in the case stated in the last preceding article, the architect does not superintend the work, he is liable for the loss only which is occasioned by defect or error in the plan furnished by him."

These articles are in substance a reproduction of corresponding articles in the Code Napoleon. The origin of the principles thus laid down no doubt is to be found in the fact that in earlier days the architect was commonly the principal contractor for the building. At that time the trade guilds still flourished and one of the rules of the guilds was that no member of any guild should contract for or do work belonging to any other guild, so that the only way to include the whole building in one contract was to make an agreement with someone outside the trades and let him make the sub-contracts for the different portions of the work. The person with whom the principal contract was usually made would naturally be the architect, and as, like any other contractor, he would be tempted to save money for himself by surreptitious means to the detriment of the strength of the building, the law made him and his sub-contractors responsible for a fixed term for the solidity of the structure. It has been held that these articles fall within the category of matters of public order, and in consequence cannot be derogated from so as to relieve the architect or engineer from responsibility, even when so expressly stipulated.

With the idea of avoiding the rigorous responsibility thus imposed upon the engineer under the Quebec system, certain engineers have been stipulating that in the execution of the works they shall act merely as the servants, agents and employees of the proprietors, and perform the work under the proprietors' direction. Although the Code only makes use of the word "building," the jurisprudence is that the word will include any large undertaking such as a dam, or other analogous work. This liability has been imposed even in a case in which the plans were made by another architect before the persons sued assumed charge of the works to be erected.

The responsibility of the architect or engineer who not only prepares the plans but supervises the work, extends not merely to the sufficiency of the plans, but also to the materials employed. Thus in a case cited in this province where the floors of a building sank in consequence of the insufficiency of the timber specified, it was held that the architect and contractor were jointly and severally liable, and in a more recent case now pending in the Appeal Courts, the architects and contractor were held jointly and severally responsible for the failure of timber which perished through dry rot. [Mr. Montgomery cited as examples of this, the case of the Royal Electric Company vs. Wand, and Wand vs. Walbank].

Engineer's Certificates

In most building contracts it is customary to provide that payment shall only be made upon the certificate of the engineer, and that the latter shall be final and conclusive as between the parties. Here again we find a certain degree of conflict between the English jurisprudence and that of our own province. Under the English jurisprudence it is held that if the certificate of the engineer is made a condition precedent to any right of payment, effect will be given to the clause, and no action can be maintained against the proprietor until a certificate has first been procured.

As to the finality of the certificate, the English jurisprudence varies according to the wording of the particular contract. If a contract contains a provision that disputes shall be referred to arbitration, the certificate of the architect or engineer will not be treated as final, even though the same architect or engineer is by the contract named as arbitrator, and in order that his certificate should be treated as final, it must have been given before any dispute has arisen. Under our own jurisprudence there is some question as to the binding force and legal effect of such a clause, and we are face to face with a flat conflict of opinion upon the point. Thus, in a case of Mireau vs. Gauthier, it is held by one of the judges of the Superior Court, that the obtaining of an architect's approval and certificates, and an order for payment on the proprietor, when such is the agreement between the parties, was a necessary condition to any demand upon the proprietor and a condition precedent to any action for the recovery of the contract price. If the architect arbitrarily refuses to comply with the just demands of the contractor, the latter can take proceedings against him to compel him to perform his functions, but he could not proceed against the proprietor. On the other hand, another of the learned judges of the Superior Court, in the case of Quinlan vs. Redmond, came to an exactly opposite conclusion, supported by weighty argument and authority, to the effect that clauses of this nature in a contract were of no legal effect in this province, and that they were to be treated as general arbitration clauses, or clauses compromisoires, which could have no effect unless they comply with the rules of the Code of Civil Procedure, that is to say, unless they specified the particular subject of the dispute, named the delay within which the award shall be rendered, and complied with the other requirements of the Code.

Must be Impartial

In one respect the jurisprudence under both the common law system and the system in being in our province is in accord, and that is, that the engineer or architect called upon to exercise the quasi-judicial function must not be placed in the position where his opinion is likely to be influenced, at least to a greater extent than is known to both parties at the time the contract is entered into. In the latter connection it is no bar to the exercise of his functions that he is employed by the proprietor and is paid by him, and is, in a sense, the representative of the proprietor, since this is a fact which would have been well known to both parties at the time the contract was entered into. The mere fact that the engineer was in the permanent employ of the contractor would not affect the finality of his certificate, or the finality of his award in the adjustment of a dispute. If, however, a secret agreement existed between the proprietor and the engineer, such as an agreement that the engineer would only act as the servant, agent and employee of the proprietor, and in all things obey the latter's directions, this would absolutely disqualify the engineer from performing any judicial function as between the proprietor and the contractor. Again, it has been held, both here and in England, that if the architect or engineer has given the proprietor a guarantee that the works would not cost more than a certain amount, this would be a fact to so influence his judgment as to disqualify him from acting as an arbitrator, or granting any certificate binding against the contractor.

Remuneration

As to the right of the architect or engineer to remuneration, this will ordinarily be governed by arrangement. In the absence of an arrangement there will be an implied contract to pay what is reasonable, usually based upon the customary charges or commissions for similar work. Where drawings are merely submitted for approval, it has been held in England that no claim for remuneration arises unless the work is approved or used, and, similarly, in the case plans or drawings submitted in competition, subject, of course, to the public terms of the competition; such probationery drawings are in the nature of a tender, that is, a mere proposal or offer to do the work, and without acceptance there is no mutuality on which an implied contract to be paid for can be placed. [Here the writer discussed a case where the court decided that plans or drawings submitted for approval and used for any purpose, should be paid for].

Where an engineer is engaged at a yearly salary, payable monthly, it has been held in this province that the contract must be construed as being by the year, and that the words "payable monthly" are a mere indication of the manner in which such remuneration is to be paid. Silver vs. Standard Gold Mines Limited. In the same case it is held that a professional, e.g., an engineer with managerial functions is not obliged to seek for menial work if he cannot find a position equal in importance to that from which he has been dismissed unjustly, and the employer, in that event, is responsible for the payment of the salary for the entire period of the contract up to the date of its expiry.

Disposing of Plans

Ordinarily, unless some particular statute provides that the originals of all plans shall remain of record with the engineer or architect, the plans and specifications that have been prepared can be claimed by the owner. Thus:—

"An architect was employed by the owner of certain houses to design and carry out the conversion of the houses into flats, and he was to receive five per cent. on the contract price for his services. The architect accordingly prepared plans and specifications, and superintended the work of conversion. At the conclusion of the work the owner paid the architect his fees, and claimed to be entitled to the plans and specifications. At the trial the architect tendered evidence of a custom in the profession by which, in the circumstances of the case, the plans and specifications were the property of the architect:—Held, that the custom was unreasonable, and that the evidence was not admissible, and that the plans and specifications belonged to the building owner: Ebdy vs. McGowan (1870), 2 Hudson on Building Contracts 7; Gibbon vs. Pease, (1905) 1 K.B. 810, 74 L.J.K.B. 502, 69 J.P. 209, 53 W.R. 417, 92 L.T. 433, 21 Times L.R. 365. 3 L.G.R. 461."

Discussion

Mr. Montgomery then discussed the ordering of extras, stating that neither an architect nor an engineer could claim remuneration unless these were ordered in writing and unless the price was fixed in writing and agreed to by the proprietor. In dealing with the clauses providing for a time limit for the completion of contracts, where there was no penalty, damage was not payable unless it could be shown that time was the essence of the contract. Mr. Montgomery also took up the question of stipulated damages and penalties, and said that the courts were disposed to alleviate what might be regarded as an extreme application of the clauses. It had been held that in the case of a delay, say in the delivery of a site, the contractor was absolved from paying stipulated damages; in fact the courts generally sought a solution which tended to reduce damages payable by a contractor.

Several questions were asked, and Mr. Montgomery elaborated many of the points of his paper. A discussion which followed was taken part in by Sir John Kennedy, and Messrs. Francis, Surveyer, Ross, Duchastel and Swan.

Walter J. Francis & Company, consulting engineers, have removed from the Commercial Union Building, 232 St. James Street, to the new Bank of Toronto Building, 260 St. James Street, Montreal.

Canadian Imports and Exports for the Year Ending February 29, 1916

THE tables reproduced herewith summarize the export and import trade of the Dominion of Canada with the rest of the world for the 12 months ending Feb. 29, 1916. Comparative figures, showing the increase or decrease over the previous year, are also included. Total imports for the year amounted to $520,335,754.00, a decrease of about eighty millions from the figures of the previous year. The total exports were $862,782,899.00, practically double of the figures for the previous year, which leaves a balance in our favor of some $340,000,000.00. Most of our imports are from the United States, the total amounting to approximately $380,000,000.00. This is a decrease from previous years of about 10 per cent. The United Kingdom has given us imports to the value of $77,582,813.00, a drop of about 45 per cent.

Principal Articles of Canadian Produce Exported from Canada.

Articles Exported.	Twelve Months Ended February.			
	1915.	1916. Total.	1916. To United Kingdom.	1916. To United States.
	$	$	$	$
Animals, living—Total	14,710,707	18,109,534	3,723,688	12,740,154
Cattle	9,136,567	12,769,705	105,120	11,314,111
Horses	1,645,573	4,167,169	3,617,947	301,270
Sheep	286,662	593,392	....	584,466
Breadstuffs—Total	110,345,860	229,034,018	186,806,451	13,286,616
Barley	3,328,807	3,491,729	2,934,257	189,888
Bran	1,030,942	1,691,898	76,985	1,495,470
Cereal foods	1,995,265	1,946,917	1,724,338	22,513
Oats	8,149,141	14,040,502	7,363,353	510,120
Oatmeal	322,438	385,808	341,786	42,199
Wheat	71,333,536	169,458,413	151,728,019	8,654,358
Wheat flour	22,708,723	35,967,133	22,152,368	1,148,667
Coal, coke, cinders and charcoal	4,615,172	6,968,986	210,001	4,319,875
Cordage, rope and twine	1,073,655	1,336,976	242,807	604,061
Fish—Total	16,737,420	21,993,592	6,736,766	8,540,797
Cod, etc., dry-salted	4,034,442	6,313,010	134,167	1,408,837
Lobsters, canned	2,890,065	2,703,610	1,256,238	538,749
Salmon, canned	4,801,297	6,401,405	5,056,633	2,592
Fruits—Total	3,318,125	3,141,762	2,602,008	345,803
Apples, fresh	2,390,797	1,880,630	1,698,764	18,172
Furs, skins and manufactures of	2,560,214	4,774,871	1,369,373	3,396,544
Hay	2,118,390	5,211,404	1,262,636	508,475
Hides and skins, other than fur	8,016,950	6,625,001	3,752	6,605,323
Leather and manufactures of—Total	6,539,024	16,587,888	8,442,127	3,920,829
Sole and upper	5,463,150	6,662,942	3,039,542	3,201,345
Metals, minerals, etc.—Total	60,928,313	118,506,247	49,478,221	54,699,940
Aluminium in bars, blocks, etc.	2,316,174	3,640,476	2,308,641	1,215,864
Asbestos	2,291,793	2,880,675	727,981	1,835,054
Copper	7,507,714	13,529,807	1,095,981	12,433,826
Gold-bearing quartz, dust, etc	15,391,155	16,655,366	100	16,655,266
Iron and steel and manufactures of	10,615,861	51,643,315	33,439,023	5,271,938
Nickel	5,057,532	7,862,125	1,885,749	5,976,376
Silver	14,209,671	14,126,480	8,190,475	5,146,314
Paper	15,365,636	19,502,728	885,043	16,278,387
Potatoes	680,210	464,070	7	22,316
Provisions—Total	40,947,195	65,405,731	59,811,153	1,749,304
Butter	631,043	1,016,757	606,916	23,165
Cheese	19,237,267	26,218,190	25,953,149	21,938
Meats—Bacon and hams	12,545,534	25,324,670	24,963,999	267,178
Seeds	11,015,869	3,397,695	198,040	3,166,687
Settlers' effects	3,577,802	4,182,086	439,576	3,684,546
Whisky	866,650	1,015,283	188,907	709,112
Wood and manufactures of—Total	51,827,510	62,556,755	15,084,953	43,875,851
Logs	994,086	1,285,835	49,359	1,236,136
Lumber—Deals, pine	1,151,310	1,248,605	1,168,696	49,539
Spruce and other	6,254,057	9,799,752	8,951,971	263,907
Laths, palings and pickets	1,840,929	2,507,461	11,268	2,481,396
Planks and boards	18,678,854	23,520,759	2,129,073	19,727,097
Shingles	2,937,253	3,662,143	....	3,643,570
Timber, square	546,404	477,558	465,820	11,738
Wood blocks for pulp	6,815,396	6,030,803	....	6,030,803
Wood-pulp	9,170,187	10,050,051	314,061	9,013,062
Total value of principal and other Articles Exported				
Canadian produce	391,000,905	698,315,322	416,610,328	195,344,199
Foreign produce	50,314,760	39,293,938	11,737,659	16,803,376
Total exports, merchandise	441,315,665	737,609,260	428,347,987	212,347,575
Coin and bullion	18,177,217	125,173,639		125,159,865
TOTAL EXPORTS	459,492,882	862,782,899	428,347,987	337,507,440

as compared with the years 1913 and 1914. Germany sent $95,552.00 worth of material as compared with $14,735,834.00 in 1914.

The United Kingdom gets the lion's share of our exports, totalling $428,347,987.00, about twice what we were giving her the year before the war. The United States is also taking more, $212,347,575.00, as compared with $183,049,307 in 1914. France also took about

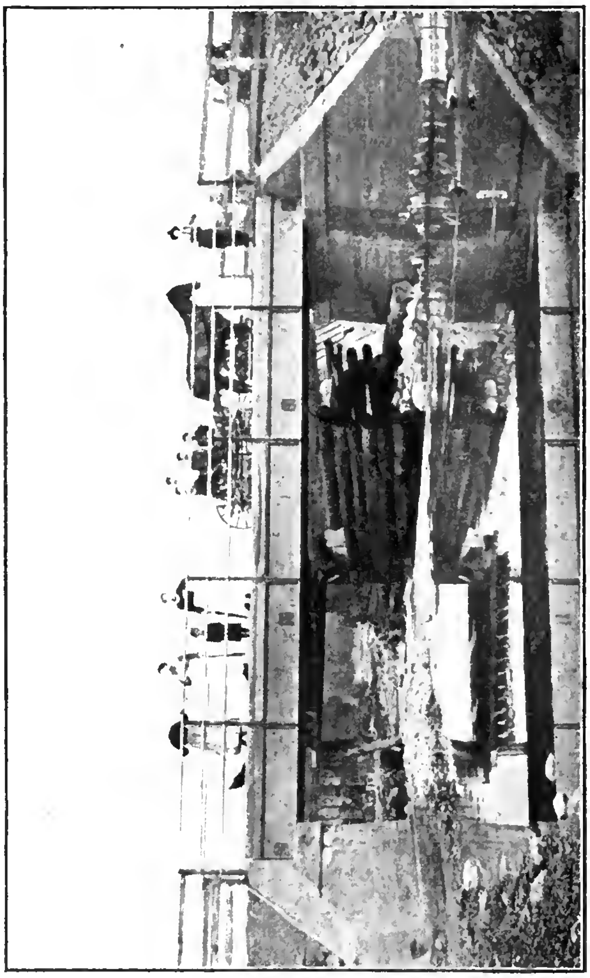
Principal Articles Imported for Consumption into Canada.

Articles Imported.	Twelve Months Ended February.			
	1915.	1916. Total	1916. From United Kingdom.	1916. From United States.
	$	$	$	$
Ale, beer and porter	767,311	240,739	121,616	117,147
Animals, living	1,419,576	625,690	64,374	554,179
Books, periodicals etc	6,089,270	5,095,069	920,795	3,967,233
Breadstuffs	13,012,784	12,044,116	235,184	9,824,746
Bricks, tiles, clays and manufactures of	2,143,367	1,623,427	204,933	1,422,570
Carriages, carts, wagons, cars, etc.	9,314,262	10,530,123	139,849	10,300,236
Cement	147,807	47,710	650	45,584
Coal, coke, etc	40,318,759	31,151,600	26,043	21,124,550
Cocoa, chocolate, etc	2,242,045	2,290,132	999,899	1,107,090
Coffee	2,118,463	1,721,242	117,503	266,922
Cordage, rope and twine	3,302,228	3,483,467	400,492	3,078,303
Cottons	28,279,832	31,284,230	10,447,077	19,741,564
Curtains	430,676	390,631	209,773	64,252
Drugs, dyes, chemicals, etc	13,621,365	16,012,902	2,492,375	11,994,978
Earthenware, china and graniteware	2,065,381	1,456,243	945,537	287,947
Electric apparatus	6,150,862	4,996,910	226,741	4,706,095
Fancy goods	3,364,062	2,832,622	909,611	1,526,117
Fish	1,772,071	1,396,367	112,539	454,457
Flax, hemp, jute and manufactures of	6,465,619	7,835,472	2,249,872	2,102,722
Fruits	15,796,574	14,050,441	362,563	12,247,864
Furs, skins and manufactures of	2,390,541	2,656,569	219,423	2,328,461
Glass	3,563,197	2,442,242	155,694	2,197,934
Gloves and mitts	1,918,727	1,299,540	595,119	298,923
Grasses, fibres and manufactures of	2,452,013	2,438,326	90,263	2,377,207
Grease	1,026,220	962,794	33,847	923,367
Gunpowder and explosives	1,134,004	1,017,320	174,425	838,229
Gutta-percha, india-rubber and mfrs. of	7,937,427	9,025,939	3,299,866	5,551,064
Hats, caps, bonnets, etc	3,987,427	3,269,519	942,227	2,110,403
Hides and skins other than fur	11,939,663	13,234,954	798,996	4,516,936
Leather and manufactures of	7,339,510	6,343,189	794,173	5,540,583
Metals, minerals, etc.—Total	88,238,324	98,062,824	5,836,129	90,966,029
Brass and manufactures of	2,968,923	3,672,525	92,996	3,554,210
Copper and manufactures of	3,810,001	4,415,146	12,185	4,400,282
Iron and steel and manufactures of	67,862,948	72,560,521	3,862,226	67,757,214
Tin and manufactures of	3,103,793	4,858,273	1,068,504	3,757,433
Musical instruments	1,490,966	1,510,270	94,590	1,366,762
Oils	14,032,506	12,504,013	518,131	11,136,624
Oilcloth	1,511,970	1,078,150	619,503	457,863
Paintings, drawings, engravings, etc	1,262,920	777,096	194,603	526,868
Paints and colours	1,611,835	1,928,563	304,321	1,563,290
Paper and manufactures of	6,052,159	4,640,558	862,655	3,667,660
Precious stones	2,130,269	987,329	676,273	118,806
Provisions	6,537,521	10,293,461	181,351	9,523,160
Ribbons	1,862,862	1,434,723	592,572	227,438
Seeds	2,303,039	2,789,132	259,821	2,462,692
Settlers' effects	8,880,474	3,918,492	455,711	3,385,826
Silk and manufactures of	8,329,018	8,401,133	1,864,148	2,669,711
Soap	1,187,108	1,057,268	108,340	862,298
Spirits and wines	5,541,065	3,888,119	2,197,038	62,150
Sugar, molasses, etc	19,220,685	22,209,988	495,272	3,044,193
Tea	7,282,763	8,370,117	3,138,719	42,499
Tobacco	5,857,231	5,452,670	573,976	4,322,814
Vegetables	3,165,651	2,177,308	33,644	1,927,843
Watches	921,028	1,013,016	66,708	637,487
Wood and manufactures of	15,656,971	8,477,118	111,395	8,040,895
Wool and manufactures of	24,960,152	28,219,793	19,576,019	6,499,920
Total Value of Principal and other articles Imported—				
Dutiable Goods	290,910,628	278,303,387	50,841,196	189,719,513
Free Goods	177,160,463	207,856,753	24,038,339	161,122,968
Total Imports, merchandise	468,071,091	486,160,140	74,879,534	350,842,481
Coin and bullion	132,955,322	34,175,614	2,703,779	28,114,117
TOTAL IMPORTS	601,026,413	520,335,754	77,582,813	378,956,598

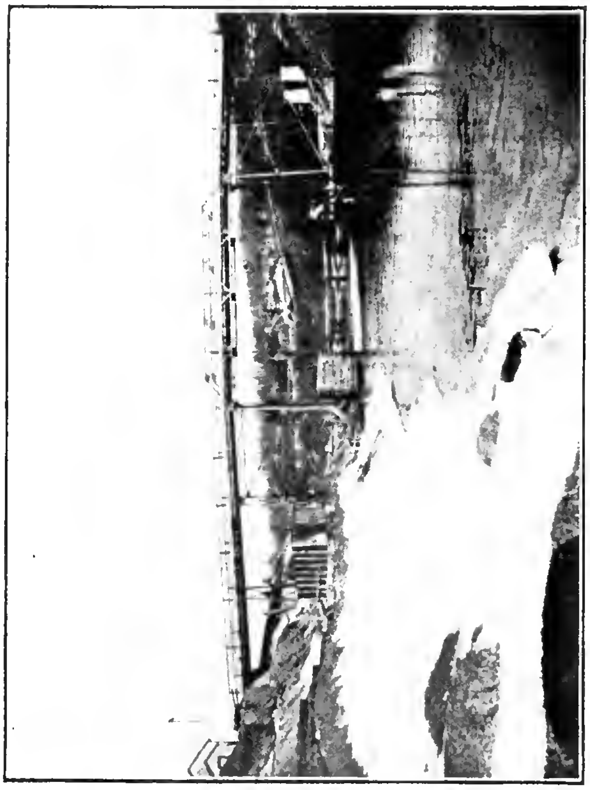
34½ millions, as compared with less than 4 millions in 1914.

A moving picture machine is being used in connection with the clean-up campaign to be conducted in Montreal by the City Improvement Association. Contracts have been let for the printing of 75,000 booklets which will be distributed through the medium of the schools, by the members of the fire department and by an arrangement whereby they will be sent out with parcels from the large stores. For backyard gardens there will be a distribution of $1,250 in prizes. There will also be special contests for school children and arrangements are being made so that seeds can be sold for 1 cent per package. The campaign is being well organized and promises to be the most successful yet conducted.

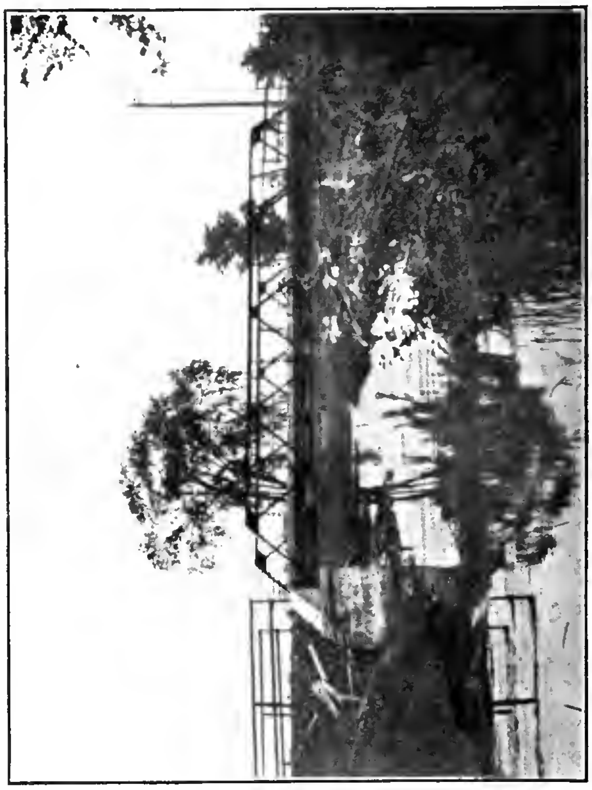
An act to provide for compensation to workmen for injuries sustained and industrial diseases contracted in the course of their employment has been introduced in the Legislative Assembly of the Province of British Columbia.



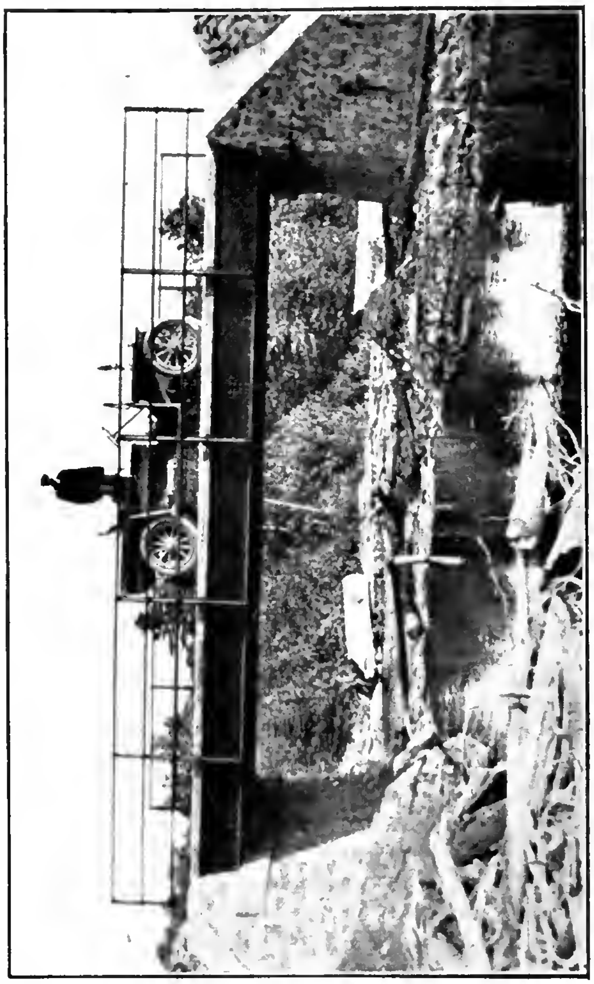
Crooked Rapids Bridge, Bonfield, Nipissing



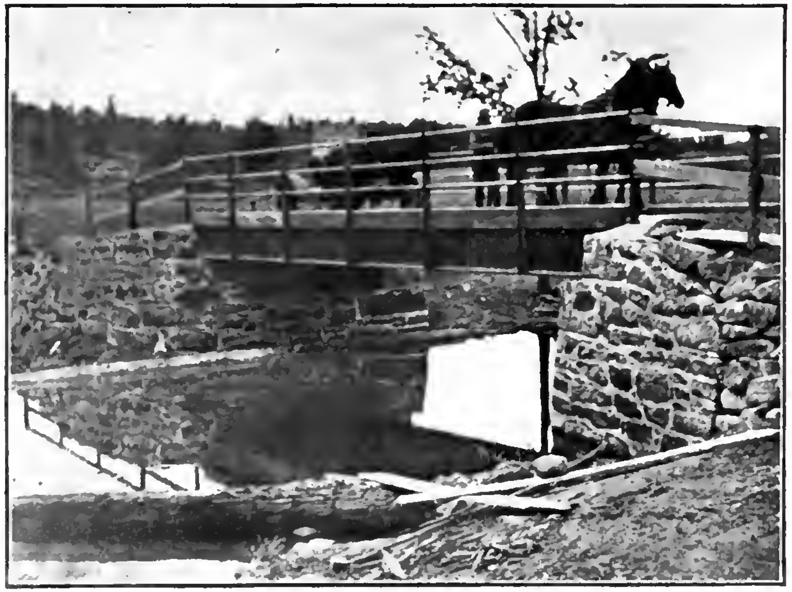
Peninsula Canal Bridge.



Carlyon Bridge, East Simcoe.



Root River Bridge, Tarentorus, Algoma, Ont.



Buck River Bridge, Ryde Concrete floor reinforced with steelcrete.

Omo Creek Bridge, Mattawa-Pembroke Road.

Sand Lake Bridge.

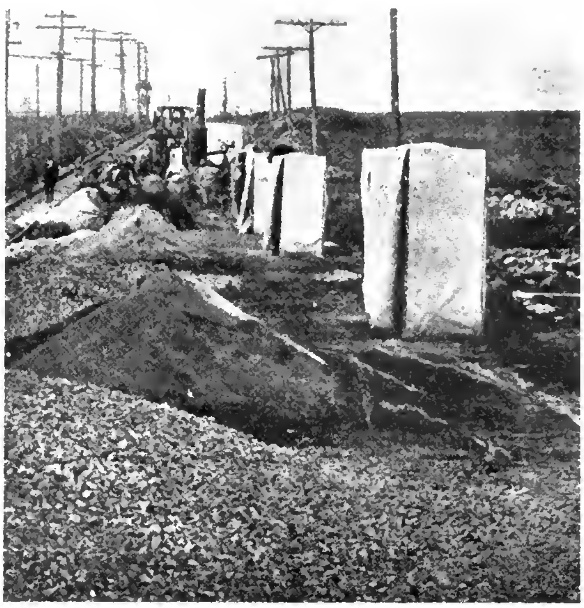
Bridge Building in Ontario

Forty-six new bridges were constructed throughout the Province of Ontario, under special appropriation, by the Department of Public Works, Mr. A. B. Halford, Provincial Engineer, during the season 1914, 1915. Of these, twenty-seven were timber bridges, pile and crib abutments, fourteen steel bridges on concrete structure, 4 steel bridges on timber abutments, and one large reinforced concrete culvert. Besides these, work was completed on several bridges under construction at the close of the fiscal year, 1914. All bridges were constructed by day labor under a regular staff of foremen, under the direct supervision of the Engineering Department. The cuts herewith illustrate a number of the bridges.

Some Novel Methods Used in the Construction of a Model Highway

HIGHWAY engineers will note with interest some of the features and unusual methods adopted by the Philadelphia State Highway Department in the model concrete road building between Easton and Allentown, a distance of approximately ten miles. Road engineers are paying more attention than ever in their endeavor to find a type of construction that will not only present a surface permanent enough to withstand present day traffic but will also be economical in the first cost and in maintenance charges. To determine the practicability of such a road, the Pennsylvania State Highway Department have, with the co-operation of the cement interests, undertaken to build this model road. The description of the work on the road was given by Mr. William D. Uhler, chief engineer of the department, before the recent American Roadbuilders' Conference, Pittsburg, in part as follows:—

In the construction of this highway, which is not yet completed, especial attention is and has been paid to every engineering detail, starting with the subgrading and drainage, thorough rolling of subgrade before placing materials, proper grading of aggregates, the exact proportioning of materials and the amount of water used. Other details closely watched are the timing of the mix, laying of the concrete, striking off and curing of the pavement.



Philadelphia Model Highway Construction—Canvas Huts for Sheltering Cement.

After the subgrade is finished accurately, drained and rolled, the forms are placed, which consist of 6-in. channels in 12-ft. lengths, held in place by steel pins; particular care being taken to have the alignment and grade of these forms accurate. The steel forms are being used both for economy and on account of the ease with which they can be handled.

Placing Materials

To eliminate the re-handling of materials, a system was devised for the proper distribution of the aggregate and cement. On this work all materials have been brought to the point of use on trolley cars, advantage being taken of the fact that the car tracks paralleled the full length of the road, making it by far the most economical way of handling the materials. This method of delivery proved advantageous for unloading sand and stone at measured intervals. Portable canvas sheds, holding 90 sacks each, used for the storage of the cement, were placed at measured distances along the route, and as emptied were moved ahead.

In proportioning the batches, the sand and stone were handled in specially devised wheelbarrows, of 3 cubic feet capacity, to insure accurate measuring, and when loaded these barrows were struck off with a shovel. The same care has been given with reference to the amount of water used in each batch, just enough being put in to secure a plastic mixture, which would not quite level down in the bucket when dumped.

Duration of Mix

Every batch of concrete is mixed for one and one-half minutes; the reason for this being that a number of experiments, made during the progress of the work, indicated that the greatest strength, commensurate with economy in cost of mixing, was obtained from a mix of this timing.

Before placing the concrete the subgrade is thoroughly wet and the concrete, which is mixed in proportions of 1:2:3, is placed to a depth of 6 in. at the side and 8 in. at the center. A heavy strike-board is then used to compact the concrete and give the road its proper form, and this board is followed by a lighter one. When the strike board comes within 3 ft. of a joint, it is lifted and placed alongside the joint. Work then proceeds away from the strike-board. After water disappears from the surface of the concrete, it is floated smooth with a wooden float. Transverse joints are placed 36 to 40 ft. apart and consist of a ¼-in. thick prepared bituminous material 9 in. wide. Part of the bituminous strip above the surface is sheared off after the concrete is placed, leaving it projecting about 1 in. above the finished surface. This part is flattened down by traffic and protects the joint. A split float is used to finish the concrete on each side of the joint, so that both sides will be at the same elevation. The edges of the joint are rounded with a 3/16-in. edger. The sides of the roadway slab are rounded with a ¾-in. edging tool.

Metal Protection Plates

Concerning the use of metal protection plates and of reinforcement in the road, Mr. Uhler says:

There is a vast difference of opinion as to the advisability of using steel protection plates at the joints. Experience leads me to believe that, if proper care is taken in the maintenance of the unprotected joints, built as outlined herewith, far more satisfactory and economical results will be attained than by the use of steel joints, especially if there is any difference in the rate of wear of the concrete and the steel in the joints. Only a thousand feet of this road has been constructed with steel protection joints, and up to the present time no advantage in this method of protection is noticeable.

The road in question is reinforced also with a light metal fabric, which is shipped to the job in sheets 5 ft. in width and 6 ft. and 10 ft. in length. This fabric is placed with longitudinal joints staggered and with a lap of 4 in. crosswise and 12 in. longitudinally. Of course, it would be preferable if sheets could be obtained the full width of the roadway. Reinforcing shipped in sheets, in my opinion, is more satisfactory because it is easier to handle and can be installed with less trouble, while with rolled reinforcement there is bound to be more displacement of the concrete when the workmen endeavor to force it into place.

This metal reinforcement is placed 2 in. below the top of the slab. It reduces the number and size of the cracks and is designed also to overcome longitudinal cracks that may occur because of the settlement of the shoulders.

Throughout the West the general practice is to build concrete roads, without reinforcement, 6 in. at the side and 8 in. in the center. Personally, I believe that far better results can be obtained at the same cost, and under some conditions at less cost, by the construction of 5-in. and 7-in. concrete roads with light metal-fabric reinforcement.

Protection While Setting

To protect it from the sun and air while it is setting, the concrete is shaded with canvas. Portable forms are used, which are set along the edges of the pavement and project about 12 in. above it. The canvas sheets are mounted on rollers laid on these forms and unrolled. After the concrete has hardened, the canvas is removed and the pavement is covered with two or three inches of earth and kept wet 10 to 14 days, when the road is opened to traffic. About 3¼ mi. of this road was completed last season, and thus far only two slight cracks have appeared.

Comparative Costs of Handling Gravel by Team and by Tractor for Roadwork

By O. L. Kipp*

THE data presented and the conclusions suggested are derived from the Gravel Checkers' records on five team hauling jobs totalling 22 miles of road gravelled and one tractor hauling job covering 3.6 miles of road gravelled; the gravel being placed at the rate of 15 cu. yd. per 100 ft. station on each job.

Team Hauling

Gravel hauling by team is familiar to all and no description of outfit or method is necessary, other than the statement that ordinary dump planks were used and 1½ cu. yd. per load were hauled uniformly. The team wagons were loaded by hand shoveling. The number of shovelers in addition to the teamsters shoveling varied from none for a portion of the time on Job No. 1 to a maximum of two on all the jobs.

The data obtained from the checkers together with percentages and averages derived therefrom have been compiled in the attached Table 1, in which is shown for each job and each haul length on each job, the following data: Total loads hauled, average number of teams hauling, average number of loads per team day, load miles per team day, per cent. of time dumping, per cent. of time in pit, per cent. of time required for loading at 12 minutes per load, minutes actually used in loading each load, per cent. of time lost in loading, average number of teams at the pit, hauling cost per cubic yard, total loading and hauling cost, contract price, and the hauling cost per cubic yard mile for each length of haul.

From the same table we also find that providing the time of loading were reduced to 12 minutes per load the hauling cost per cubic yard mile would be as follows: 0 to ½-mile haul, 43 ct.; ½ to 1-mile haul, 27.8 ct.; 1 to 1½-mile, 23.8 ct.; 1½ to 2-mile haul, 22 ct.; 2-mile haul and over, 21.5 ct. If the loading time could be reduced to 6 minutes per load the hauling cost per cubic yard mile would be further reduced as follows: 0 to ½-mile haul, 34.1 ct.; ½ to 1-mile, 24.5 ct.; 1 to 1½-mile, 21.7 ct.; and above that, 21.5 ct. per cubic yard mile.

Also, on a 12-minute loading basis the cost per yard for the hauls would be as follows: 0 to ½-mile, 13.5 ct.; ½ to 1-mile, 20.5 ct.; 1 to 1½-mile, 29.8 ct.; 1½ to 2-mile, 38.5 ct.; (2 plus X) miles, 44 ct. plus 22 miles.

The data in the table warrants these conclusions for we find in Job No. 2 on the ½ to 1-mile haul the cost was 22.9 ct. with an 8.7 per cent. loss of time at the pit; on the 1 to 1½-mile haul the cost was 29.4 ct., as compared with 29.8 ct. as estimated, while on the 1½ to 2-mile haul of Job No. 3 the cost was 38.4, as compared with the estimated cost of 38.5 ct. and on a 2.95-mile haul the cost was 67 ct., with a 12.3 per cent. loss of time as compared with the estimated cost of 65 ct.

It would thus appear that efficiency in team hauling and consequent low cost is largely dependent upon and might easily be secured by obtaining the maximum efficiency in loading. This problem is by no means as easy as that of the hauling for many varying conditions are encountered. The total loading and hauling cost on the various jobs was figured to provide for the shovelers actually employed and $5 per day additional for the general superintendence of a foreman or the contractor. The resulting loading costs varying from 7 ct. to 25 ct. per yard, the lower figures being too low on account of the teamsters acting as shovelers while waiting to get into the pit and the highest figures being boosted on account of an excessive amount of frost and firewater, and poor supervision. The lowest job average for loading was secured on Job No. 2, it being 9 ct. per yard. Favorable pit conditions were a large factor in producing this low figure. It would appear that for average pits 10 to 15 ct. per cubic yard should cover the item of loading by hand. Whether or not some mechanical loader would be able to reduce this item I am unable to state.

Tractor Hauling

The failure successfully to solve this mechanical loading problem contributed in a large measure towards increasing the figures I am able to present on gravel hauling by tractor.

The tractor hauling outfit used in Redwood County

*District Engineer, Redwood County, Minnesota; before Minnesota Engineers' and Surveyors' Society.

TABLE I.—GRAVEL HAULING COST DATA, REDWOOD COUNTY, MINNESOTA.

Length of haul	0-½ mile.			½-1 mile.			1-1½ miles.					1½-2 miles.				*	†	‡
Job No.	1	2	5	1	2	5	1	2	3	4	5	1	3	4	5	3	3	1
Total No. loads hauled	407	475	482	327	1571	364	606	525	898	44	746	312	873	434	198	337	267	714
Average No. teams hauling	7.2	5.2	4.5	9.6	7.0	9.0	6.5	7.6	7.0	6.0	8.7	6.4	7.5	5.2	4.6	8.0	7.2	18.7
Average No. loads per team day	12.1	14.0	9.45	9.75	11.67	7.35	7.0	9.1	7.55	7.33	6.0	6.4	6.93	6.73	5.35	4.6	4.0	3.9
Load miles per team day	4.24	4.62	2.83	7.31	8.75	6.51	8.75	11.38	9.44	9.16	7.50	9.45	12.13	11.78	9.36	10.35	11.00	11.51
Per cent time dumping (5 min. per load)	10.0	10.9	7.8	8.1	9.7	6.1	6.8	7.6	6.3	6.1	5.0	4.5	5.8	5.6	4.4	3.8	3.3	3.2
Average actual time in pit per load	30.6	25.0	46.0	26.6	16.5	46.7	30.7	11.0	24.4	24.5	45.0	36.0	11.5	14.2	37.2	36.0	35.1	30.9
Per cent actual time in pit per load	61.7	58.3	73.3	43.2	32.0	57.2	35.9	16.7	30.7	32.9	45.0	32.5	13.3	15.9	33.2	27.2	23.4	20.1
Per cent time required for loading at 12 min. per load	24.2	28.0	18.9	19.5	23.3	14.7	14.0	18.2	15.1	14.7	12.0	10.8	13.9	13.5	10.7	9.2	8.0	7.8
Per cent of time actually lost in pit	37.5	30.3	54.4	23.7	8.7	42.5	21.9	....	15.6	18.2	33.0	21.7	....	2.4	22.5	18.0	15.4	12.3
Average No. of teams at pit	4.5	3.0	3.3	4.1	2.2	6.1	2.3	1.3	2.2	2.0	3.9	2.0	1.0	0.8	1.5	2.2	1.7	3.8
Hauling cost per cu. yd. in cts	21.9	19.0	28.3	27.3	22.9	36.3	38.1	29.4	35.3	36.4	44.4	49.4	38.4	40.0	50.0	58.0	66.7	67.0
Total cost per cu. yd. in cts., loading and hauling	29.9	28.0	38.3	34.3	30.9	46.3	49.1	39.4	47.3	51.4	56.4	66.4	51.4	60.0	75.0	76.0	89.7	76.0
Contract price per cu. yd., cts	45.0	39.0	35.0	60.0	50.0	45.0	70.0	65.0	65.0	60.0	65.0	85.0	80.0	75.0	80.0	107.5	122.5	109.0
Spreading cost per cu. yd., cts	2.00	2.25	3.75	1.75	2.00	2.50	3.75	2.50	3.00	3.75	3.00	5.00	3.25	5.00	6.25	4.50	5.75	2.25
Hauling cost per cu. yd. mile, cts. (actual)	73.0	57.6	94.3	36.4	30.6	48.4	30.5	23.5	28.2	29.1	35.5	28.2	22.0	22.8	28.5	25.8	24.3	22.7
Hauling cost per cu. yd. mile., cts. (with 12 min. for loading)	43.0	43.0	43.0	27.8	27.8	27.8	23.8	23.5	23.8	23.8	23.8	22.0	22.0	22.0	22.0	21.2	20.6	21.2
Hauling cost per cu. yd. mile, cts. (with 6 min. for loading)	....	....	34.1	24.5	....	....	21.7	....	....	....	....	....	....	....	....	....	....	....
Hauling cost per cu. yd., cts. (with 12 min. for loading)	....	13.5	....	....	20.5	....	29.8	....	....	....	....	....	38.5	....	....	....	....	....
Hauling cost per cu. yd., cts. (with 6 min. for loading)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

Above figures based on 25 cts. per hour for man alone and 40 cts. per hour for man and team.

*2-2½ miles. †2½-3 miles. ‡2.95 miles.

consisted of a 30-60 Holt Caterpillar Gas Tractor and a train of 7 Troy 3½-yd. reversible spreader wagons, a 50-yr. storage bin and a belt conveyor loader.

Difficulties were encountered from the very start. Considerable time was consumed in erecting the storage bin and loader. When the first train was finally loaded ready to start it was found that the tractor would not pull more than two cars over a short sharp pitch at the railway crossing on the most direct route. After some investigation and experimenting it was found that four cars could be hauled across private fields to the top of a short pitch about ¾ of a mile from the pit and that by doubling back for the remaining three cars a train of 5 cars could be made up and hauled the remaining distance of 2¼ miles. A total of 1,365 cu. yd. was hauled in this way over an average haul of 3 miles or a total of 4,125 cu. yd. miles at the average rate of 129 cu. yd. miles per day, which on a basis of $20 per day to cover the cost of operation, interest and depreciation, was at the rate of 15.4 ct. per cubic yard mile for the hauling.

From the next pit they hauled a total of 1,584 cu. yd. onto a stretch from 1 to 3.6 miles distant, making a total of 3,422 cu. yd. miles. There were no grades greater than 2 per cent. on this stretch and they made an average of 142 cu. yd. miles per day on this work, the cost being 14.1 ct. per cu. yard mile. In several days they were able to make as high as 216 cu. yd. miles, which would be at the rate of 9.2 ct. per cubic yard mile.

From the foregoing it would appear that the cost of hauling by tractor was considerably less than by teams. The advantage in favor of the tractor would have been even greater, in my opinion, had there been more power available. A 40-80 tractor would have made a much better showing. Another factor cutting down the capacity of the train was the inability of the loading equipment to supply gravel fast enough. With ample power to pull six cars and a train load of gravel always ready when the train arrived at the pit there is no doubt that the record of 9.2 ct. per cubic yard mile made on a few days could have been maintained throughout the job.

However, in tractor hauling it is essential, as I have suggested, to have a bin full of gravel ready to dump into the cars quickly when the train arrives at the pit, for the outfit cannot make any money while waiting to be loaded. A bin of from 25 to 30 cu. yd. capacity must be provided. The bin must be portable, easily transported from pit to pit. This portable feature is essential for the loading apparatus also. Unfortunately my experience in this instance does not prepare me to tell you what equipment is practical, but I can tell you that a belt conveyor and a non-portable bin is not practical for I've seen them tried and the cost of tearing down, moving and re-erecting the bin amounted to fully 10 ct. per yard of gravel handled. The belt conveyor may be successful on a level grade or a very slight incline, but when it comes to raising the gravel about 30 ft. vertically you have gone beyond the practical range of a belt conveyor. I have no definite data as to the cost of loading with this apparatus, but as nearly as I can estimate it was between 25 and 30 ct. per yard, which together with the cost of moving the bin makes a total loading cost of 35 to 40 ct. per yard.

It would seem with the proper equipment the total loading cost should not exceed 10 ct. per cubic yard. If this is possible the comparison between tractor and team hauling is very much in favor of the tractor.

Besides the cost there are other features in favor of the tactor hauling which I wish to point out briefly. First: By applying the gravel in two courses with a tractor you get your gravel rolled without additional cost and the road is ready for travel as soon as the gravel is applied instead of a month or more later as with teams. Second: By loading into a bin; thence to wagons and thence to the road you obtain an efficient mix of the materials so that instead of having one load with good gravel with a fair amount of binder followed by a load of sand with no binder and the resulting hard bump and chuck hole a few weeks later you have a gravel of uniform consistency which does not tend to develop waves or chuck holes.

Big Machine Plant

The city council for St. John, N.B., has ratified the taxation agreement made with Messrs. T. McAvity & Sons in 1914, looking to the erection of a large iron and brass foundry on the Marsh Road, immediately adjacent to the I. C. R. tracks. It is understood that the firm have recently been awarded a heavy order for munitions and that they will rush the erection of their plant in order to fill this order. The agreement calls for the expenditure of $100,000 the first year. This the firm are prepared to do? The plant that the firm have in prospect will be one of the largest in the lower provinces.

Improved Granite Block Pavements

The Evolution of the Commercial Stone Paving Block—Some of the Present Methods in Modern Highway Construction

By C. F. Knowlton*

Stone block pavements are perhaps the oldest type of street paving known. The early Romans paved streets with large irregular shaped stones, often two or three feet in depth, the joints being filled with smaller stones wedged in with mortar. The earliest type of stone pavements in this country were built with round field stone and beach cobbles, laid in sand, with joints filled with gravel. More recently quarry-split rectangular or cube paving blocks, of which there was an abundant supply in the granite hills of Maine and Massachusetts, came into prominence in the New England States. These blocks were usually about 12 inches square on top and from 8 to 12 inches in depth, laid on natural soil in a sand bed with sand joints. This made a very permanent pavement, but it was rough and uneven.

Following this, smaller blocks were used, but these also settled, when laid in a sand bed, leaving an uneven surface. About 1880 concrete foundations for street paving came into general use. The size of the blocks was then reduced, both in surface area and depth, builders figuring that with a concrete base much less depth of brick would suffice.

This line of reasoning caused them to adopt a block 4 to 4½ ins. deep, 3½ to 4½ ins. wide, and 6 to 12 long. Laid on a concrete base with cement grouted joints, this proved to be an ideal pavement and opened up an era of improved granite block paving. The engineers of some of the large cities hesitated to make such a radical change from a deep block to such a shallow block, but made concessions in favor of shallower blocks. The consequence of this was the paving cutters were obliged to cut different sizes for different localities, but the requirements were more strict as to the quality of the stone and the fineness of the cutting.

Block Sizes

In 1912, an effort was made by a committee of the officials of the large cities to standardize paving specifications and resulted in recommending a special size paving block to be called the "standard." This was not so universally adopted as was expected and as a result the paving block manufacturers are at present turning out a number of different sizes and grades of granite paving block, each known among the trade in New England by a special designation.

A block 4 to 4½ ins. deep, 3½ to 4½ ins. wide, and 6 to 12 ins. long, will require about 31 blocks to a square yard with joints not to exceed ¾ in. in width.

The "standard" size block is 4¾ to 5¼ ins. deep, 3½ to 4½ ins. wide, and 8 to 12 ins. long, cut to lay about 28 blocks to a square yard with joints not to exceed ½ in. in width.

The "N. Y. special" size block is 6 to 10 ins. long, with ⅜-in. joints.

The "Boston special" size block is 5 to 5½ ins. deep, 4 to 4½ ins. wide, and 8 to 12 ins. long, joints not to exceed ½ in. in width.

The "6-inch" size block is 6 to 7 ins. deep, 3½ to 4½ ins. wide, and 9 to 14 ins. long, cut to lay about 25 blocks to a square yard with joints not to exceed ¾ ins. in width.

*Before American Road Builders' Association, Pittsburgh.

The "city" block is 7 to 8 ins. deep, 4 to 5 ins. wide, and 9 to 14 ins. long, cut to lay about 23 blocks to a square yard with an indefinite joint.

The "track" block is 5½ to 6½ ins. deep, 3½ to 4½ ins. wide, and 6 to 12 ins. long, rather rough cut and with an indefinite joint.

In addition to these regular trade sizes, the manufacturer is often called upon for special sizes for special conditions, among which is the "durax" size. These are cubes of from 2½ to 4 ins. It is obvious that so many sizes of granite blocks leads to confusion and irregularity in method and cost of construction and in the pavement surface.

Standard Types

During the year 1915, the Granite Paving Block Manufacturers of the United States decided to confine their production of blocks to three sizes, except where specials were called for to meet some peculiar requirements, like track paving, etc. These three sies are:

The "standard" size block as given before.

The "shallow standard block," size 4 to 4½ ins. sq. and 7 to 11 ins. long, cut to lay with joints not exceeding ½ in. in width.

The "resurfacing" blocks, designed to be used for resurfacing on original foundation when asphalt, wood block, or brick pavements, are to be replaced, size 3¾ ins. to 4½ ins. wide, 3½ to 4 ins. deep, and 7 to 11 ins. long, cut to lay with joints not exceeding ½ in. in width.

These sizes and all special blocks are all cut and split by hand labor, have square edges, smooth surfaces and lay with close joints. All of these sizes may be termed "improved granite blocks."

Improved granite block, having square edges, smooth surfaces and close joints, are usually laid on a concrete foundation.

The "6-inch," "city," and "track" are considered as rough cut blocks of the old type and are laid with wide joints, generally on a gravel base and with sand or gravel joints.

No engineer should accept or specify a stone block pavement which failed to result in an even surface in every way acceptable for both horse and automobile traffic. To secure this smooth even surface, it is necessary for the engineer to require a carefully split stone block having no projections exceeding ⅜ in. from a true plane, and that the blocks be laid in the street on a properly drained sub-foundation, a substantial concrete foundation, and with close, even joints, and these joints be filled with a rich mixture of cement grout or with a bituminous filler of asphalt or pitch.

The use of the two different fillers is largely a question of prospects of future openings being made in the pavements. If frequent openings and quick repairs are necessary, the bituminous filler is more convenient and economical, openings can be made easily and the surface replaced satisfactorily without loss or wastage of blocks. Where openings are not apt to be frequent or where traffic conditions will allow the street to be closed for a period to allow the cement grout filler to properly harden, the cement filler should be used and will give a smooth surface, protect the edges of the blocks, and give better results usually than the bituminous filler.

Subgrade

A firm subgrade and a strong concrete foundation are just as essential in laying a stone block pavement as they are in laying other types of smooth pavements. It is true, however, that many grouted stone block pavements have been laid without a concrete foundation and some have been in small cities and towns where the traffic could not be considered heavy and where the sub-soil is especially good. Danger lies in the liability of the blocks to settle under heavy loads; if this occurs in the slightest degree the bond of the cement is broken and it scales off and loosens in the joints.

In this type of pavement it is necessary to use a deep "city" block and have the cement grout fill the joints their entire depth to get the necessary stability.

The cost of handling and transporting these deep and heavy blocks is nearly twice that of the small blocks and in localities far removed from the quarries it will be found that a 4-in. stone block can be laid on a concrete foundation, requiring no more excavation and less labor and cement, for less money and will give a more permanent smooth surface.

As to the construction of improved granite block pavements, I will describe the methods we used in constructing nearly a million square yards in Massachusetts and Rhode Island in the past ten years.

In excavating and preparing the subgrade, great care is taken to have the subsoil thoroughly compacted by a steam roller and hand tamps, all soft and spongy material is removed and good firm dry material takes its place, especial care being taken to see that newly filled trenches are well compacted. The subgrade is left smooth and exactly parallel with the proposed finished grade. On this subgrade a well mixed concrete base is laid 6 ins. in depth. On good undisturbed natural soil a 1:3:6 mixture is strong enough; on filled ground where underground pipes have recently been laid a 1:2½:5 mixture should be used.

Concrete Foundation

We usually lay our concrete foundation by the grouting and compression method. Many tests made show that for equal thickness, the compressed concrete is 33 per cent. stronger under a bending strain and 40 per cent. stronger under a compression test, than ordinary mixed concrete, hence under this method the thickness of a concrete foundation can be reduced to 4 or 5 ins. with perfect safety and with a considerable saving in costs.

A layer of egg-size crushed ledge stone is placed on the subsoil and rolled to the required thickness. A Portland cement grout is then poured into the stone and the stone rolled during this process until all the voids are filled and the grout flush with the surface. The grout is mixed in different proportions according to the thickness and character of the wearing surface of the pavement. One part of cement and four parts of sand is most generally used. This is mixed in a patented grout mixer operated by a gasoline engine and which is self-propelling.

The sand, cement and water are carefully measured by volume for every mix and the grout is distributed evenly into the stone through pipes long enough to cover the entire width of the foundation. Concrete foundations laid in this manner have proven very successful. They can be laid much faster than by the ordinary method and cause less obstruction to travel in the handling of materials. The surface of the concrete base is left smooth and exactly parallel with the proposed surface. Upon this we place our sand cushion. This should never be more than 2 ins. nor less than 1 in. in depth. We prefer a maximum of 1½ ins. In some cases we have used a dry mortar bed, ½ to 1 in. in depth, mixed in proportion of one cement to three or four of sand, but do not recommend it. When it sets up the pavement is too much of a monolith and is noisy. A sand cushion deadens the noise of traffic and furnishes a little elasticity to the pavement, which is essential.

Cushion

The cushion is to compensate for any irregularities in the depth of the blocks and to give a uniform bearing to the bases. In the old type of blocks the variation was 1 in. and sometimes as much as 2 ins. in the depth, hence, if shallow blocks were laid in with deep blocks, the strength of bearing would be unequal and under traffic the shallow block would be pounded down, causing an uneven surface. The improved blocks are cut with only ½ in. variation in depth and the thickness of the cushion is therefore more uniform. The granite paving blocks are laid on this sand cushion by the most experienced pavers we can find. Blocks are laid in regular courses end to end across the street at right angles to the curb. Joints are broken by a lap of at least 3 ins.

Clean ½-in. pea stone is then scattered over the surface and broomed into the joints, only enough being used to steady the blocks while being rammed. The blocks are then rammed to a firm, unyielding bed with a 60-lb. rammer or rolled with a 6-ton tandem roller until the surface is smooth and regular.

Granite paving blocks should be of medium grained granite showing an even distribution of constituent minerals of uniform quality and texture, without seams, scales or discolorations showing disintegration, free from an excess of mica or feldspar. Usually a better selection of granite can be made by reference to past performance of any particular granite from any particular quarry than to attempt to make a selection from local tests.

Where a cement filler is to be used, the granite blocks need not be cut so fine and the joints can be wider than where a bituminous filler is used. We find that blocks 4 to 4½ ins. deep, 3½ to 4½ ins. wide and 6 to 12 ins. long are most suitable for this purpose and have used them in 75 per cent. of our work.

Joint Filler

Filling the joints in the pavement is the most important part of the construction, as upon it depends the smoothness and permanency of the surface.

We seldom use a bituminous filler, as it does not protect the edges of the block as they should be. After a few years the filler is worn down in the joints and the edges of the blocks become rounded and the pavement becomes rough and noisy. Nearly all our improved granite pavements have a cement filler.

We first wet the blocks until they have absorbed all the water possible and keep them wet until the grout is applied. The grout is composed of one part of cement and one part of clean sharp sand with enough water added to make it of the consistency of thin cream. This is mixed in our self-propelling grout mixer which travels on planks placed on the pavement. The grout is kept constantly agitated until it reaches the joints and every mix is exactly alike. The grout is run directly on the surface and broomed evenly into the joints.

During this operation clean pea stone, well wet, is lightly scattered into the grout and broomed into the joints. After this grout has subsided in the joints and before the initial set takes place, the surface is again treated with a grout of the consistency of thick cream which is evenly broomed over the surface until the joints are full and flush with the top of the blocks. A rubber of wood squeegee, or scraper, is then used to scrape off all the surplus cement from the surface.

The effect of this is to leave the depressions in the block filled with cement while there is none on the projections, thus making a smooth surface. When the cement is sufficiently hardened, the surface is sprinkled from a can and a fine floor brush used to brush and smooth out all irregularities. After the cement is set, the surface is copiously sprinkled and kept wet for three or four days.

All travel is kept off the pavement for six to ten days. Plenty of water is used to wash the blocks—you cannot get satisfactory results if dirty blocks are used. The joints must be open sufficiently to allow the grout to flow in and penetrate to the bottom. The cement must not be allowed to set too quickly and in very dry weather the surface should be kept covered with wet sand for at least three days.

Expansion Joints

On a business street, we lay a felt expansion strip ½ in. thick and 6 ins. wide, along the curbstone, between the blocks and the earth. This acts to deaden the sound and prevents vibrations being carried into the buildings. Where there are car tracks in the street, the web of the rails is plastered with cement mortar flush with the outside of the head of the rail, after the foundation is laid. This allows the blocks to lay firmly against the rails and still not be affected by any slight movement of the rails.

If cars are running during the grouting operations, the shaking and vibrations of the rails may cause the blocks to "float" that is: the vibrations cause the block to shake and the fresh grout works down under the block forcing them up, a little above the head of the rails. In such cases the cars should be kept off the tracks until the grout has well set, in fact, it is desirable that cars be kept off during the whole time paving operations are going on and for six days after completion. If this is impossible, they should be made to travel very slowly.

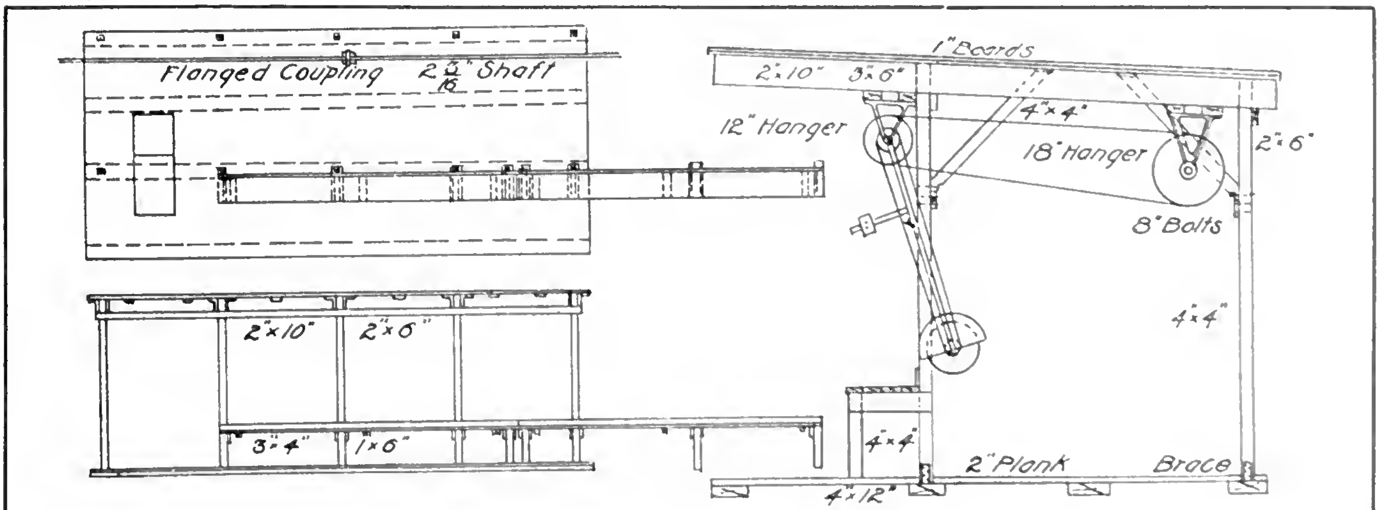
As "Eternal vigilance is the price of liberty," so it is with improved granite block pavements. Careful attention to the quality and kind of materials and constant watchfulness in putting them together are the true secrets of our success.

When you lay a pavement that is going to last forty or fifty years, you cannot afford to take any chances in its construction. You should have the best material and the most expert assistance you can get. Do not consider first cost too seriously. What does a few extra dollars amount to on the first cost of a pavement that will cost you nothing for upkeep, if properly laid, and at all times and seasons meet the demand of all classes of traffic? The cost of improved granite block will vary a great deal in different localities.

Making Forms for Concrete Work in a Model Shop Built in the Field

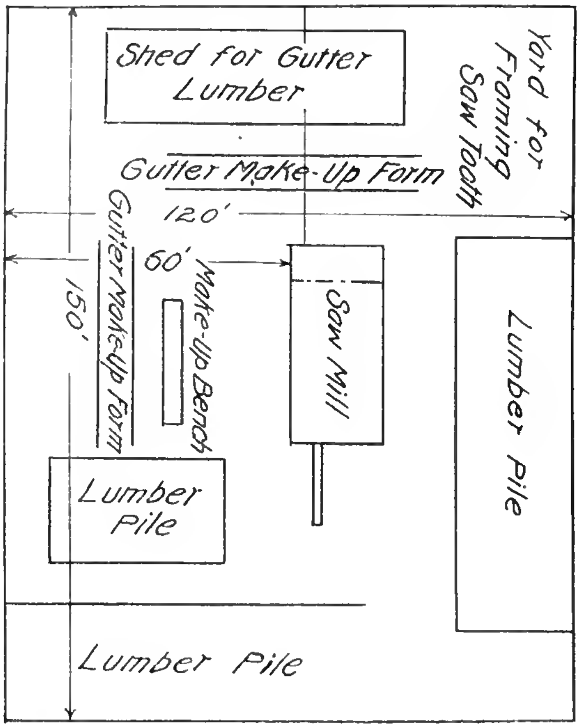
REINFORCED concrete enjoys probably the largest field of endeavor today of all the building materials. All sorts of public and private buildings, public works, dams and retaining walls, etc., are now almost universally built of either massed or reinforced concrete. With the increasing use of concrete and the complexity of design to gain a more artistic effect in the architectural features, the problem of the design and construction of the necessary forms becomes a most intricate problem. The carpentry work of form making is now a large factor in reinforced concrete construction, both as to cost and in the quality of the finished work.

For a contract of any considerable size, a large carpenter force of skilled mechanics is necessary to cut, shape and place the forms in advance of the concrete



Plan, elevation and enlarged section of an open mill.

gangs. If the design is at all complicated, the forms become ever so much more so, and require a great deal of skill in making and setting them. Of late years any contractor building concrete structures, to save

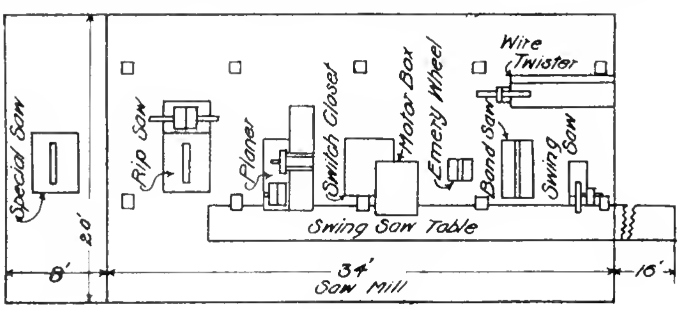


Layout plan for yard for form making.

labor almost invariably has, on the ground, some arrangement for preparing forms and other lumber and timber details—usually a small carpenter's shop, or an open planing mill, set up in charge of a competent carpenter. All lumber used in the construction of the work, besides that for scaffolding, studding, bracing, etc., is repared in this shop.

The carpentry work of form building is such a large item in re-inforced concrete construction that the handling of this work to the best advantage means working up the lumber on power saws and assembling it on special benches, made for the purpose, to obtain the maximum efficiency and lowest cost factors. Mr. S. T. Koon, a contributor to the "Cement World," describes the standard shop of a large Boston concrete company, who use the plans, as shown, on most of their jobs, enlarging them whenever necessary.

They handle all form-making by power machinery, right on the job, employing for the purpose several power saw rigs and portable wood-workers. The cuts



Plan of mill showing arrangement of machinery.

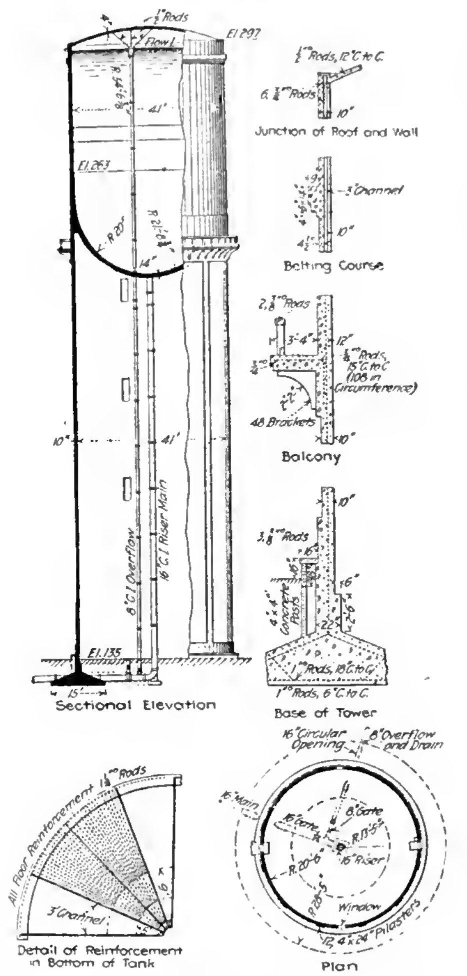
show a standard set of their plans, which can be extended, if necessary, to suit any requirements. The location of lumber in relation to the shop is shown. The shed measures 34 ft. x 15 ft. 6 in., while an extension of the saw bench carries the length 16 ft. further. An over-hanging section of the roof is 7 ft., bringing the total length of the roof to 31 ft., with the total length of the saw bench 57 ft.

Such shops can be quickly and economically built by any large contracting firm in the cement business, and would save considerable time, expense and labor, and prevent hold-ups of the concrete gang, due to carpenters being behind time. The principal tools necessary would be a swing saw, band saw, rip saw, and planer, with any special machinery that would be deemed advisable for the particular contract. Such machinery could be driven from a central line shaft run by electric motor where electric current is cheap and convenient, or by a gasoline engine, if the plant is isolated.

The benefit of such a system is, that forms are generally cut truer and more uniform resulting in a smoother face on the concrete, carpenters are kept busy all the time in spite of other delays and they are generally able to keep the forms so well in advance as to exclude the possibility of a hold-up on their account. Slack periods alternating with rush periods are done away with; work becomes a steady operation from start to finish; scientific management of the shop and the materials, after carefully planning their location relatively to the wok, eliminates any excessive handling of material and reduces the carpentry bill for form-making to a minimum.

World's Highest Reinforced Concrete Water Tank

What is claimed to be the highest reinforced concrete water tank in the world, was recently built for



Plan, elevation and sections of world's highest reinforced concrete water tank.

the city of Middleboro, Mass., and is described by the Blaw Steel Construction Co., Pittsburg, whose forms were used in the construction, as follows:—

Concrete was chosen for this tank and the tower supporting it for several reasons. The cost of a steel tower and tank would have been less, but the life would be short and the repairs, painting, etc., would also cause more expense than a concrete tank. In addition to this, the concrete could be finished in an artistic and attractive way and as designed and built is very pleasing from an architectural standpoint.

The bare surface of the tower is broken up by twelve 4 by 24-inch pilasters and at the junction of the tower and the tank, 108 feet above the ground, is a balcony of reinforced concrete with bracket supports. The details shown here give an idea of the design and the reinforcing that was used.

The tank itself is of the same inside diameter as the tower, which is 41 feet, and will have a depth of water in it at the center of 59 feet when full. The bottom of the tank is hemispherical, which is the first time that this type of construction has been attempted with concrete tanks.

Blaw steel forms were used for the outside of both the tank and the tower. They were justified because of the reduction in time and expense that attended their use and they also formed a dense, smooth surface that required very little finishing. Their forms as used on the tank and tower were made as two rings, each 4 feet wide. Wooden forms were used on the interior.

The Larger Use of Canadian Timber

Toronto Architect Urges the Use of B. C. Fir in Preference to U. S. Pine; and Canadian instead of U. S. Architects

MR. A. R. DENISON, of Denison & Stephenson, Architects, Toronto, recently addressed the Lumbermen's section of the weekly meeting of the Toronto Board of Trade, on the importance of Canadians using Canadian lumber whenever possible, and for closer co-operation between architects, lumbermen and owners of buildings under construction for the prompt settlement of accounts for supplying material.

Separate Cheques for Lumber Bills

Mr. Denison recited a specific case of misunderstanding between owner, contractor and lumberman, wherein the lumberman did not receive his proper compensation, and suggested as a remedy that the owner pay the lumberman direct. The speaker went into this situation more in detail and finally asked why something should not be done to put the whole situation beyond any peradventure. It seemed to him this would be quite easy if the interested parties would get together. His idea was that an arrangement should be made in writing between the proprietor and the contractor at the time of signing the contract, requiring the contractor to submit to the proprietor a summary of the lumber to be used in the building; and further, that a statement should be rendered to the proprietor from time to time during the continuance of the work, and that the proprietor should be required to draw separate cheques in favor of the lumber merchant as each certificate became due; the lumber merchant to be subject to a drawback clause of 80 per cent. in the contract and also to have a claim upon the 20 per cent. retained by the architect; a duplicate statement to be rendered to the architect if required. He believed that a plan of this sort, in which the owner, the architect and the contractor co-operated would remove a great deal of trouble. If the lumbermen would take it up and pass a definite resolution in regard to it, asking the architects to co-operate, he would put the matter before the architects, and felt pretty sure that they would fall in line.

Use Canadian Materials

Mr. Denison is a strong advocate of using Canadian woods wherever possible. He referred to the fact that the original Toronto city by-law made Georgia pine the basis for timber construction purposes. He had asked the city architect to use B. C. fir for such purposes and had simply been told that it was not allowed by the by-law and could not be done. This was a mistaken view of the city architect. He should have been interested solely in the strength of the timbers used, not the variety of timber. Although he expressed this opinion to the city architect at that time, the reply he received was simply that Douglas fir was not allowed by the by-law and he would not permit it to be used.

However, Mr. Denison, against the advice of the city architect, made preparations for building two houses, one to be built of Douglas fir and the other of Georgia pine, and was hailed before a judge, who permitted him, after seeing tests on the two timbers, to go ahead. Tests were made upon both Georgia pine and Douglas fir. The Georgia pine selected was 8¼ in. x 19¾ in. x 18 ft. long. The Douglas fir stick was 8 in. x 19¾ in. x 18 ft. long. The tests were made at the School of Practical Science, Toronto. The Georgia pine stick broke off at 43,550 lbs., and the Douglas fir stick split lengthwise but did not break at 55,320 lbs. From that day on they had been allowed to use Douglas fir.

Douglas Fir

Douglas fir was unquestionably the best wood they could get for construction purposes. It was also the strongest wood and it was one of our own native woods. He urged that lumbermen, architects and contractors should put forth every effort to use Canadian materials on Canadian buildings. Mr. Denison referred to instances of failure that he had come across in using Geogia pine. He had been obliged to take out at least six sticks of long leaf pine within five years from the time they were put in, because of dry rot. There seemed to be a failure in a certain percentage of Georgia pine stock. It really required an expert to know Georgia pine. In fact, he had known men who called themselves experts, who differed with one another in deciding whether certain southern timbers were long leaf pine or not. He had always found that Georgia pine checked to a greater extent than Douglas fir. It was also much more combustible, as it was full of gum and was easy to set on fire.

The speaker urged that lumbermen commence at once upon an effort to encourage the use of Canadian woods. The Dominion Government had taken a step in this direction by passing an order that nothing but Douglas fir was to be used in the construction of public works. If an effort were made along this line and followed up vigorously it would make a great difference to Canadian lumber manufacturers. He understood that during the last year over four million dollars worth of Georgia pine had been imported into Canada. In normal times he understood that the amount was far greater.

Employing U. S. Architects

Underneath all this was a question of vital importance to Canadians, frequently one would see a company with a name that would lead one to suppose that it was a Canadian company, who in the construction of large buildings employed U. S. Architects. The U. S. architects would naturally specify U. S. brick, U. S. wood, etc. Every lock, every fitting, the plumbing, everything throughout the building would be brought in from the United States because the architect would be getting his percentage on every one of these items. Canadian architects would not be allowed to put up buildings in the United States. Canadian dentists, veterinary surgeons, lawyers, doctors, all classes of professional men, except the architects were protected against this sort of thing. Moreover the brick-layer and the carpenter were also protected in Canada to a certain extent by the alien labor law. In this way the U. S. firms were cutting both the lumbermen and the architect out of their own business. In order to carry out this kind of work the contractor who wanted to make use of a U. S. architect had no trouble at all. He simply obtained blue prints and had them put through the customs at their cost, paying in duty a nominal sum of a few dollars. Under present conditions there was no escaping from this situation, but he believed that the architects, on a short time, would make an effort to have the law enforced more fairly in connection with the importation of plans.

After an interesting discussion on Mr. Denison's remarks, Mr. Reid, the chairman, stated that together with M. W. J. Hetherington, he would draw up and present at a later meeting of the board a resolution upon Mr. Denison's proposal, and he hoped that in the near future something definite would be forthcoming.

Activated Sludge Sewerage Experiments*

THE Sanitary District of Chicago began experiments with the activated sludge process of sewage treatment on Stockyards and Packingtown sewage in April, 1915. The operation on the fill and draw plan was carried on in two galvanized iron tanks, each holding approximately 200 gal. of sewage. These experiments were continued well into the cold season, being discontinued when the contents of the tanks froze solid. Certain observations were made, which can be explained by the effect of low temperatures upon the process. These observations were substantiated on the larger 4 unit installation of the Sanitary District designed to treat from 30,000 to 100,000 gal. on the continuous flow basis daily. This installation was put into operation early in 1916 and is under the direction of Langdon Pearse.

The changes of the nitrogenous constituents during the aeration process have been carefully studied. Our experience has coincided, so far as I am aware with the experience of other observers. During the warmer season a reduction of the free ammonia to about 1 or 2 p.p.m., and an increase of the nitrites to 5 or 10 p.p.m., indicates complete oxidation and clarification. This ceased to be the case, however, when colder weather set in with the small galvanized iron tanks, which were easily affected by changes in temperature in the air. Absolute stabilities were reached in cold days with the free ammonia actually increasing several hundred per cent, and with little, if any, change in the nitrites and nitrates. The reduction of the organic nitrogen was just as marked as in summer. Clarification was very satisfactory. The results I speak of are those noted when the effluent showed a relative stability of 100 or thereabouts. With the small galvanized iron tanks, in which the warm sewage quickly chilled, it took a considerably longer time in the cold weather to obtain such a high stability, but the chemical results were consistently as noted.

It is clear that in such cases the mechanical features of the process outweighed the biologic features. The highly putrescible colloids have simply been whipped out of suspension by the continuous agitation. Repeated observations indicate that the mere mechanical removal of the colloidal matter from sewage brings about an improvement far out of proportion to the actual percent of substance removed. There is no doubt, however, that there is some biologic activity even in a liquid near freezing, otherwise, we could hardly account for the persistent increase in free ammonia. We further noted various active protozoa, such as infusoria and trachelomonas in the sludge at all times. More highly developed animal or plant organisms were not found. Our work indicates that the temperature of the liquid treated will be a controlling factor. On a large scale temperature changes will probably be much lower than on the very small scale of 200-gal. steel tanks exposed to weather.

During the cold weather we had no ready chemical index to go by, although the regular routine tests of long duration were available. The removal of the colloidal matter was the only immediate indication of accomplished oxidation. This forced us to determine regularly the turbidity of the settled aerated sewage. Used with the methylene blue putrescibility test, a fairly definite working relation can be established. The tabulation of a large number of results obtained shows that the stability is 100 with turbidities of 10 p.p.m. or less. With a turbidity of 15 p.p.m., the relative stability varies usually between 50 and 100. With turbidities above 15, the quality of the effluent shows rapid deterioration. At turbidities ranging from 20 to 25 the stabilities are usually below 50. To compare turbidities above 25 p.p.m. with stabilities appears unsafe. Such stabilities are without exception very low. The relation spoken of is bound to vary with sewages of different character. Recently with the advent of warmer weather, the nitrites are again picking up in the effluent, and no doubt our ammonia index will again serve the purpose. The determination of other constituents, such as the organic nitrogen albuminoid ammonia, permanganate oxygen consumed, chlorine and the bacterial content, are merely of scientific interest. They are not essential for a routine control. This

*Extracts of a paper by A. Lederer before the American Chemical Society.

holds good to a certain extent for the dissolved oxygen, but it is quite conceivable that the rate of de-oxygenation at a given temperature can be made to serve as an index of the degree of stabilization accomplished. The quantity of the settling suspended matter in the final effluent merely indicates the efficiency of the settling process, and has nothing to do with the activated sludge process proper. Packingtown sewage completely oxidized by the activated sludge process is clear with a slightly yellowish tint barely noticeable in small bulk.

Sturtevant Contracting Set

The following illustration shows a new adaptation of the Sturtevant gasoline generating set. These sets are intended to be used in direct connection with lighting and power circuits and not through storage batteries, although they may be so arranged if desired. A very sensitive governor control, together with other fineness in design of engine and generator, insure a constant voltage through wide variations of load. The unit consists of a direct current electric generator direct connected to a gasoline engine. A switchboard and gasoline tank is also included. A special type of disc fan is mounted on an extension of

Sturtevant Gasoline Contracting Set.

the generator shaft and arranged to blow air through a cellular type radiator. All of this apparatus is mounted upon two channel irons and the engine generator and switchboard are covered by a sheet metal housing, similar to an automobile hood. The engine is of the four cylinder, water cooled, vertical type with either four or six cylinders, according to the size of the unit. Three sizes of these sets are built, 5 kw., 10 kw., and 15 kw. capacity capable of lighting 200, 400, and 600, 20 candle power tungsten lamps. Both engine and generator are capable of operating under an overload of 25 per cent. for two hours.

Trade Inquiries

Names and addresses may be obtained from the Department of Trade and Commerce, Ottawa.

362. **Steam-electric power plant apparatus and engineering specialties.**—A gentleman who intends visiting New Zealand during the coming summer is desirous of securing the agencies of Canadian engineering manufacturers of steam-electric plant apparatus and engineering specialties, and is desirous of receiving full technical description of apparatus together with illustrations, weight of apparatus, shipping weight, and weight of heaviest piece, and over-all dimensions. Present prices either f.o.b. Canadian or American port or c.i.f. New Zealand port.

384. **Glass.**—An English firm of glass importers inquires for Canadian exporters of glass for lighting purposes and table use, to replace supplies formerly imported from Germany, Austria and Belgium.

377. **Brassed rods.**—A Birmingham bedstead manufacturer is open to purchase cased brass rodding. Samples on file at the Department of Trade and Commerce. Prices must include delivery Birmingham or Liverpool.

Personal

Mr. C. Dufort, architect, has removed from 198 St. Catherine Street West, to 195 St. Catherine Street East, Montreal.

Major Howard Dinnel Bodwell, of the 2nd Pioneer Battalion, was recently wounded in action. Major Bodwell was an engineer in civil life in Vancouver, and saw active service in the South African campaign.

Mr. J. Quail, until recently sales' engineer of the Manitoba Bridge & Iron Works, Winnipeg, has taken up new duties with the Canadian Bridge Company, Walkerville, Ont., as manager of their Winnipeg office.

Mr. George D. Mackie, City Engineer-Commissioner, Moose Jaw, Sask., has been appointed a member of the Royal Commission recently formed to enquire into and report on the work of the Provincial Highways Department of Saskatchewan carried out by that body from 1913 to 1916.

Obituary

Mr. D. Gladstone, head of the Fort William Granite Works, recently died at his home in Fort William. Mr. Gladstone, who was a prominent business man of Fort William, had been in ill health for some time.

The death occurred recently in England of Mr. Harold A. Copp, formerly head of the Copp Stove Works of Fort William. Mr. Copp has been an active business man and was a widely-known philanthropist, taking special interest in Y. M. C. A. work in Fort William.

At a largely attended meeting of the Quebec branch of the Canadian Society of Civil Engineers, held on the 17th inst., a resolution was passed expressing sympathy with the relatives of their late colleague, Mr. L. B. Verge, C.E., in his untimely demise, and with Mr. W. D. Baillarge, C.E., on his recent bereavement.

The death occurred recently of Mr. Albert C. Smith, president of the Smith Foundry Co., one of Fredericton's most prominent business men. Besides being president of the Smith Foundry Company, he also acted as mechanical superintendent of the plant, and had been directing operations in munition work of both the day and night crews. His death was caused by pneumonia contracted during a recent fire in the company's plant.

The death occurred recently of Dr. W. F. King, Chief Astronomer of Canada and Commissioner for the Survey and Marking of International Boundaries, at the Observatory residence, Ottawa. The late Dr. King was born in England in 1854, came to Canada at the age of eight, and entered the Dominion Government service as Assistant Astronomer on the North American Boundary Commission in 1872. In 1886 he was made Chief Inspector of Survey, and in 1890 Chief Astronomer of the Department of the Interior.

The Halifax Electric Tramway Company, who are constructing a gas plant at Halifax, are also calling tenders for the erection of a by-product building, cold storage building, and for elevating and conveying machinery in connection with the same.

Mainly Constructional

East and West—From Coast to Coast

Building outlook in Calgary for the coming year, according to R. G. Dun & Company, looks particularly bright.

The Alliance Power Company, Limited, has recently been incorporated in Edmonton, Alta., with a capital of $250,000.

Building operations in the city of Quebec continue active during the last week. Permits amounting to $63,060 were issued at the city hall.

It has been decided to rebuild the isolation hospital on Sandy Point Road, St. John, N. B., recently destroyed by fire. The new building will cost $15,000.

The work of constructing the joint sewerage system of the villages of New Toronto and Mimico, is in full swing. A big effort is being made to have the system ready for use this year.

The Municipal Concrete Construction Company, of Ingersoll, have placed an order with Wettlaufer Bros. for two heart-shaped, traction paving mixers, and one tilting drum, heart-shaped mixer.

The Board of Control of the city of Toronto have refused the request of the T. Eaton Company to allow them to place the footings of their new building beyond the street line of Terauley Street.

The plant of the Union Cement Company, Owen Sound, who are working on a 50,000 barrel contract for the city of Toronto, recently sustained damage by fire. Reconstruction work will begin at once.

Messrs. Barott, Blackader & Webster, architects, Montreal, are preparing plans for a large moving picture theatre to be erected on Sherbrooke Street, Westmount, for the Imperial Theatre Company.

Following the consideration of a large number of tenders, the city of Kingston have awarded the contract to Wettlaufer Bros. for one heart-shaped traction paving mixer, with boom and bucket attachment.

Work on the Toronto-Hamilton highway in the Port Credit district is progressing rapidly; a part of the road will be closed temporarily to traffic in order that the railway for hauling cement and material may be laid.

Sackville, N. B., has just finished one of the most successful clean-up and paint-up weeks in its history. The usually attractive little town has been rendered much more attractive by the renovation it has received.

The work on the new Great Northern depot at False Creek, near Vancouver, is being rapidly pushed forward by the contractors, Grant, Smith & McDonnell. Pile driving has started and concrete work on the piers is expected to be under way shortly.

Interned alien enemies within Canadian territory are at present employed in building good roads through the Canadian Rockies. Camps are located at several points in Alberta and British Columbia, and so far the aliens are doing valuable productive and development work, as a return for the care being taken of them during the present period of stress.

As a result of the determined fight of John Allen, member for West Hamilton, it is believed that the government may agree to give a substantial special grant for the construction of a high level bridge to link up Hamilton with the Toronto-Hamilton highway and do away with the objectionable steep grades involved in the present plan. The bridge, which will be partly outside the city limits, would benefit other places as well as the city.

A provisional school in military engineering has been authorized for the benefit of the civil engineers in Ottawa at the request of the Ottawa branch of the Canadian Society of Civil Engineers, and has been largely attended by the civil engineers of that city. Colonel Maunsell, Director General of the Engineer forces of Canada, assisted by Lieutenant Attfield, and Sergeant-Major Innes, have charge of instruction.

St. Vincent's High School for Girls, St. John, N. B., which is to be built in that city under the direction of Bishop LeBlanc, will be one of the largest and most up-to-date school buildings in the province. The building will be 107 by 130 feet, three storeys in height. There will be twelve classrooms, besides chemical and physical laboratory, domestic science room, recreation room, assembly hall, gymnasium, swimming pool and shower bath.

The will of the late Robert Davies has been filed for probate, and shows in summary—real estate $896,898, money secured by mortgages $14,045.42, book debts $36,928.09, securities for money, life insurance, cash in bank, $121,059.08, bank and other stock $24,000. The real estate comprises extensive properties throughout different parts of the city. For the Don Valley Brick Works, no amount has been inserted in the schedule. The title to this property is in litigation and no value can be placed upon it until the litigation is terminated.

The city of St. John, N. B., is now revelling in the possession of one of the finest post offices in eastern Canada. The removal from the old to the new building took place a few days ago. The new building occupies a site on the eastern side of Prince William Street, almost opposite the old building and facing the harbor. The general entrances are on Prince William Street, while the mails enter from Canterbury Street in the rear. The front of the new building is of granite and freestone, ornamented with large columns, which give it an imposing appearance.

A large deputation of public men, residents of Niagara Falls and Stamford, will go to Ottawa shortly to interview the Department of Railways and Canals and ask that body to give its official approval to the plan to make the proposed Hydro-electric power canal navigable between Chippewa Creek and Niagara Falls, a plan which, if successful, is expected to make Niagara Falls the leading industrial city of the Niagara peninsula, also converting it into a lake port. The plan is to make the canal 50 feet wide and 16 feet deep, large enough to accommodate lake steamers.

Mr. Justice Weir has given judgment in the Superior Court in favor of C. Dufort and J. T. Decary, architects, who claimed $1,250 from Carl Rosenberg as fees for the preparations of certain plans they drew up on defendant's order in May, 1912. The defendant pleaded that as he had not utilized the plans he was not bound to pay for them. To follow them would have made the building he wished to construct too costly. Therefore he had to obtain new plans more in accordance with a building of his means. "All the same," ruled the judge, "you must pay for the first set of plans that you ordered made."

The entrance piers at the graving dock at St. Joseph de Levis have been completed, and work on the structure is beginning to take a tangible form. Up to the present the work has been rather of a preparatory nature, but the entrance pier is completed and the excavations for the dock itself well begun. The dock, when completed, will be 1,150 feet long, 120 feet wide at base, and 144 feet wide at top. It will be divided into two sections, the inner section 650 feet long, enclosed by a floating gate weighing 600 tons, the outer section 500 feet long, built with a rolling caisson gate of 650 tons. The structure will be concrete, faced with granite. Crib work will take 7 million feet of British Columbia fir.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Beverley, Alta.
The Town Council have let a contract for grading and other improvement on Alberta Avenue to Malcolmn McCrimmon, 9814-103rd Street, Edmonton. Approximate cost, $4,617.

Charlottetown, P.E.I.
R. S. & W. S. Lea, New Birks Building, Montreal, will receive tenders until May 20th for the erection of a pumping station and installation of a pump with a capacity of one million gallons per day, to be driven by oil engine.

East Zorra Township, Ont.
The Township Clerk, Edwin Parker, Tavistock, will receive tenders until May 8th for the construction of a quantity of tile drains with cach-basins, etc. Specifications with the Clerk and the Engineer, F. J. Ure, Woodstock.

Edmonton, Alta.
The City Council contemplate laying pavement on 101st Street at an approximate cost of $6,780, and pavement and sidewalks on a portion of Portage Avenue, to cost about $167,200. Engineer, A. Haddow, Civic Office.

London, Ont.
The City Clerk, S. Baker, will receive tenders until 9.30 a.m., May 12th, for the construction of storm sewers, estimated to cost $60,000. Consulting Engineers, Chipman & Power, Mail Building, Toronto.

The construction of pavement on Adelaide Street and Cove Road is being considered by the City Council.

CONTRACTS AWARDED

Ottawa, Ont.
Tre City Council have awarded contracts for the construction of asphalt and wood block pavement to the Ottawa Construction Company, Central Chambers, at $51,937.

Petrolia, Ont.
In connection with the rebuilding of a sewer for the Town Council, the contract for supply of tile has been awarded to the Toronto Pottery Company, Dominion Bank Building, Toronto. Work will be done under supervision of Street Commissioner Barnes.

Toronto, Ont.
The following contracts for pavements have been let by the Board of Control:—asphalt on Fisken Avenue, Godson Contracting Company, Manning Chambers, asphalt on Hiawatha, Indian Grove and Lincoln Streets, Contracting & Paving Company, Ltd., Confederation Life Building; bitulithic on Western Avenue, Works Commissioner Harris.

Railroads, Bridges and Wharves

Enniskillen Township, Ont.
The Michigan Central Railway Company Detroit, Mich., are having plans prepared for a steel bridge over Bear Creek, estimated to cost $60,000.

Lansdowne, Man.
Tenders on the erection of a reinforced concrete bridge over the White Mud River will be received until 1 p.m., May 16th, by the Municipal Secretary, M. E. Broughton, Arden. Plans and specifications at office of the Highway Commissioner, Winnipeg, and with the Secretary.

London, Ont.
The London & Port Stanley Railway Board propose to construct additional sidings and a covered timber platform, and will start work shortly. Secretary, William Spittal, c/o Peoples Building & Loan Company.

York County, Ont.
The City Council will have plans prepared for a bridge over the Humber River at Bloor Street. Engineer, F. Barber, 57 Adelaide Street E., Toronto.

CONTRACTS AWARDED

Charlotte County, N. B.
The contract for steel superstructure required for the bridge to be built over the Waweig River for the Provincial Department of Public Works has been let to the Canadian Bridge Company, Ltd., Walkerville, Ont.

Public Buildings, Churches and Schools

Beauport, Que.
Tanguay & Lebon, 20 d'Aguillon St., Quebec, have been appointed Architects for the rebuilding of the Parish Church. Curate, L. A. Deziel.

Berlin, Ont.
Tenders on all work except heating and wiring required in the erection of a church for the Polish Roman Catholics will be received until May 15th by A. W. Holmes, Architect, 10 Bloor Street E., Toronto. Approximate cost, $45,000.

Fassett, Que.
Charles Bodeur, 63 City Hall Street, Hull, is preparing plans for a Parish Church, to cost about $25,000, and will call for tenders about the middle of the month. Frame, brick veneer, stone and concrete construction.

Ford City, Ont.
The Public School Board propose to build a school at an approximate cost of $35,000, and plans will be prepared by J. C. Pennington, La Belle Building, Windsor. Brick and reinforced concrete construction.

Happy Thought, Man.
The Trustees of School District No. 1152 propose to build a school at an approximate cost of $12,000. Municipal Secretary, Thomas Bunn, Selkirk, Man.

Kingston, Ont.
The Department of Public Works, Ottawa, are preparing plans for a Riding School, estimated to cost $18,000. Secretary, R. C. Desrochers

Medelec, Que.
The Municipal Council intend to erect a school, at an approximate cost of $1,500. Secretary, F. A. Blouin.

Montreal, Que.
J. Sawyer, 107 Guy Street, is preparing plans of a Presbytery for the Roman Catholic Parish of St. Catherine.

Ontario Province.
Provision has been made in the estimates of the Provincial Government for the following works:—Brockville, alterations and additions to Hospital for the Insane, $9,800; Burwash, construction of Industrial Farm, $40,000; Fort William, construction of Industrial Farm, $30,000; Guelph, alterations and additions to buildings and plant of Reformatory, $5,000; Haileybury, construction of a Gaol, $5,000; Hamilton, alterations and additions to Hospital for the Insane, $12,900; Kingston, alterations and additions to Hospital for the Insane, $5,400; London, alterations and additions to Hospital for the Insane, $11,900; Mimico, alterations and additions to Hospital for the Insane, $7,000; Orillia, additions and alterations to Hospital for the Insane, $8,500; Penetanguishene, additions and alterations to Hospital for the Insane, $5,000.

Ottawa, Ont.
The Baptist Congregation are considering the erection of a church. Pastor, Rev. Neil Herman, 550 Gilmour Street.

Charles Brodeur, 63 City Hall Street Hull, is preparing plans of a church for the Greek Roman Catholic Congregation and will call for tenders towards the end of the month. Approximate cost, $17,500. Frame and brick veneer construction.

The Pas, Man.
Work is expected to start this spring on the erection of a Court House and Gaol for the Provincial Department of Public Works. Appoximate cost, $50,000. Engineer, G. N. Taylor.

Thorndale, Ont.
Plans of a school are being prepared by Watt and Blackwell, London, Bank of Toronto Building, and tenders will be called shortly. Brick, stone and concrete construction. Approximate cost, $15,000.

Union-on-the-Lake, Ont.
Tenders will be received until May 15th for the erection of an addition to the hospital of the Essex County Health Association. Architect, J. C. Pennington, La Belle Building, Windsor. Estimated cost, $15,000.

CONTRACTS AWARDED

Avon, Ont.
The general contract for the erection of a school has been awarded to George Craik, Mossley R.R. No. 2. Approximate cost, $6,000. Pressed brick construction.

Belleville, Ont.
In connection with the Home to be erected for the Children's Aid Society,

the contract for plumbing and heating has been let to J. H. DeMarsh, Front Street.

Brockville, Ont.
The General Hospital Board have let the contract for heating and plumbing required in the erection of a Home for Old Women to George Ross & Company, King Street, sheet metal and roofing to McFarlane-Douglass Company, Ltd., 34a Dorchester Street W., Montreal, plastering to McNulty Brothers, 182 Mountain Street, Montreal, electrical work to A. G. Dobbie, King Street W., and marble work to Calkins-Leete Ltd., 1013 St. Catherine Street W. Montreal.

Cartierville, Que.
In connection with the church basement which is being built on Main Street for the Roman Catholic Congregation, the contract for seating has been let to D. L. Benoit & Fils, 195 Timothee Street.

Montreal, Que.
In connection with the school now being built for the Cote des Neiges Roman Catholic School Commissioners, the contract for cut stone has been let to C. Piche, 2169 Papineau Avenue, the brick work to E. Rochefort, 258 Nicolet Street, and terra cotta work to Montreal Terra Cotta Company, Ltd., 42 St. Sacrament Street.

The contract for seating in connection with the church now being built for the Parish of St. Pierre Claver has been awarded to Paquette & Godbout, St. Hyacinthe, Que.

Nassagaweya Township, Ont.
The general contract for the erection of a school has been let to Davie Menzies, Milton, at $3,300.

Quebec, Que.
In connection with the Parish Church now being built, the contract for roofing has been let to C. Labrecque, 53 Sauvageau Street, and the basement plastering to the general contractors.

The contract for plastering at the school which has been built for the Roman Catholic School Commissioners has been awarded to G. Therrien, 34 Wolfe Street, Levis.

Work is about to start on the erection of a monastery for the Rev. Fathers St. Sacrament, 368 Mount Royal Avenue, Montreal. The general contract, masonry, carpentry and interior fittings contracts have been awarded to L. G. Fauteux, St. Benoit, Que., who is now receiving tenders on other trades. Approximate cost, $70,000.

Sandy Bay, Que.
In connection with the erection of a church for the Roman Catholic Congregation, the contract for roofing has been let to C. Labrecque, the painting to E. Gervais, 88 Baggot Street, Quebec, and heating to Jobin & Paquet, 78 Cote d'Abraham, Quebec.

Toronto, Ont.
The Board of Education have awarded the contract for an iron fence at Roden School to the Page Wire Fence Company, Ltd., 1137 King Street W., and the following contracts in connection with their Administration Building on College Street:—cabinet work, D. Springman, 288 Bathurst Street, $13,250; ornamental iron work, Luxfer Prism Company, Ltd., 100 King Street W., $2,940; ventilators, Buskard Machine Company, 15 Pearl Street, $1,097.

Wolfe Island, Ont.
In connection with the church which is now being erected for the Roman Catholic Diocese, the contract for metal roofing, heating, electrical work and tinsmithing has been awarded to F. R. J. Macpherson Company, 341 George Street.

Youngstown, Alta.
The School Board have let the general contract for the construction of a school to the Alberta School Supply Company, 10125-104th Street, Edmonton. Approximate cost, $8,500.

Business Buildings and Industrial Plants

Belleville, Ont.
The City Council are considering the erection of a Fire Hall. Clerk, J. W. Holmes.

Bethune, Sask.
The Royal Bank of Canada propose to build a bank, and tenders have been received. Achitect, N. R. Darrach, 68 Western Trust Building, Regina. Approximate cost, $4,500.

Elderslie Township, Ont.
James Dudgeon, Concession 12, Tara, is considering the erection of fireproof barns, to cost about $3,000.

Enniskillen Township, Ont.
John Stapleton, Concession 8, Petrolia, is considering the erection of a fireproof barn to replace that recently destroyed by fire. Approximate cost, $3,000.

Eramosa Township, Ont.
Stanley Leslie, Fergus, Ont., is considering the erection of a fireproof barn to replace that recently destroyed by fire. Approximate cost, $3,000.

Forest, Ont.
Howard Fraleigh is about to start work on improvements to warehouses, estimated to cost $10,000.

Fort William, Ont.
Work by day labor has been started on an addition to an elevator on the River Front for N. M. Paterson & Company, Ltd. Frame crib construction, concrete and pile foundation. Approximote cost, $30,000.

Hamilton, Ont.
The Hamilton Bridge Works, Bay Street N., propose to build an addition to their premises, and have had plans prepared. Steel and concrete construction. Approximate cost, $7,500.

Plans have been prepared for an addition to the premises of the Dominion Sheet Metal Company, to cost about $6,000. Galvanized iron construction. Owners will do all work.

F. Crawford, 497 King Street W., has commenced the erection of a block of stores and apartments, estimated to cost $10,000. Brick and concrete construction.

Harrow, Ont.
The W. Clark Company, Ltd., 83 Amherst Street, Montreal, propose to build a cannery, and plans are being prepared by R. Findlay, 10 Phillips Place, Montreal. Appoximate cost, $15,000.

Hull, Que.
Plans have been prepared by William St. Laurient, 12 St. Henry Street, for a store and flat to be built for P. Drapeau, Frontenac and Chateauguay Streets. Tenders will be called in about one week. Approximate cost, $3,500. Frame and brick veneer construction.

Montreal, Que.
M. Tessier, Les Cedres, Que., is considering the erection of four stores and residences on Sherbrooke Street W., at an approximate cost of $5,000.

Plans have been drawn for a carriage shop to be built on Catherine Street by S. W. Halliday, 20 Arlington Avenue. Brick and concrete construction. Estimated cost, $6,000.

Plans are being prepared for stores and apartments to be built at Spadina and Somerset Streets for Charles Joyce, 883 Somerset Street. Tenders for smaller trades will be called shortly. Estimated cost, $12,000. Brick veneer and concrete construction.

Petrolia, Ont.
Tenders will be called immediately for part of the work required in the erection of an office for the Crown Savings & Loan Company. Architect, Russell W. Soper, 166½ Front Street, Sarnia. Fireproof construction.

The erection of a store on Main Street is contemplated by R. Stirrett. Estimated cost, $15,000.

Port Arthur, Ont.
H. R. Halton, Port Arthur, is preparing plans of a block of stores and apartments, estimated to cost $6,000.

Preston, Ont.
Hope Brothers contemplate repairs to their store, which was recently damaged by fire to the extent of about $3,500.

Quebec, Que.
T. R. Peacock, Architect, 81 St. Peter Street, will receive tenders until May 8th for the erection of a building for the Y. W. C. A., 125 Ste. Anne Street. Brick, steel and terra construction. Estimated cost, $50,000.

Arthur Drapeau, 158 Ste. Helene Street, has had plans prepared for a theatre to be built on St. Joseph Street, at an approximate cost of $25,000. Brick, stone and steel construction. Work will start in about one month's time.

Esdras Lavoie, Romaine Lairet, contemplates the erection of a store and residence, at an approximate cost of $10,000. Brick and concrete construction.

Ruthven, Ont.
William Tapping & Sons propose to build two drying kilns and a large barn, estimated to cost $3,000.

Simcoe, Ont.
The Unique Shoe Company propose to build a factory at an approximate cost of $10,000, if a by-law to grant them certain concessions is approved. Secretary, J. W. Phillips, 10 West Market Street, Montreal.

Springbank, Ont.
The Victoria Amusement Company propose to erect a large frame building to accommodate a merry-go-round. Particulars from George Holding, c|o London Street Railway, London.

Toronto, Ont.
The T. Eaton Company, Ltd., 190 Yonge Street, will receive tenders until May 6th for the erection of an office and warehouse at Teraulay and Alice Streets. Architects and Engineers, William Steele & Sons Company, 423 Ryrie Building. Brick, reinforced concrete and terra cotta construction.

The Board of Control will receive

tenders until May 9th for the erection of a cottage at the Women's Industrial Farm, Concord, nt. Plans at office of the City Architect.

George Kerr, 509 Confederation Life Building, has had plans drawn for a dairy building, estimated to cost $5,500. Brick construction.

G. Lucas, 5 Playter Crescent, has commenced the erection of a block of stores and apartments, estimated to cost $15,000. Smaller trades will be let. Brick construction.

The Toronto Hydro Electric Commissioners, 226 Yonge Street, have had plans prepared for an addition to the transformer station at Front and Cherry Streets. Tenders will be called shortly for trades other thon brick and concrete work. Approximate cost, $6,000.

Work by day labor has been started on the erection of a factory for the Flint Varnish & Color Company, Perth Avenue. Estimated cost, $150,000. Brick and concrete construction.

Welland, Ont.
The Hydro Commissioners propose to build an addition to the transformer station at Hellems Avenue and Lincoln Street and to purchase equipment, at an approximate cost of $40,000. Secretary, H. E. Zimmermon.

Westmount, Que.
The Imperial Theatre Company, Bleury Street, Montreal, contemplate the erection of a theatre on Sherbrooke Street. Architects, Barott, Blackader & Webster, New Birks Building, Montreal.

CONTRACTS AWARDED

Cap Madeleine, Que.
The contract for supply of reinforcing steel required in the construction of paper mills for tht St. Lawrence Paper Company, 524 Board of Trade Building, Montreal, has been let to the Burlington Steel Company, Homilton, Ont.

Guelph, Ont.
Work is about to start on the construction of a foundry for the Guelph Stove Foundry. The contract for masonry has been awarded to W. E. Taylor, Eramosa Road, the carpentry to G. A. Scroggie, Elora Road, and painting to Dennis & Bennett, Suffolk Street.

Hamilton, Ont.
The general contract, masonry, carpentry and roofing required in the erection of a factory for the Stanley Steel Company, Arthur Avenue, have been let to John MacBeth, 25 Fife Steet. Frame and concrete construction. Approximate cost, $5,000.

Leamington, Ont.
Wesley Link, Leamington, has been awarded a contract for the erection of a warehouse for the Rock City Tobacco Company, 244 Dorchester Street, Quebec, and will start work at once. Corrugated iron construction. Approximate cost, $5,000. The Company have decided not to build the brick factory previously reported.

London, Ont.
The general contract for remodelling stores for J. C. Duffield, c|o City Gas Company, hos been let to John Hayman & Sons, 432 Wellington Street. Approximate cost, $7,000.

Marieville, Que.
J. P. Leduc has awarded the general contract for the erection of a store to Ernest Dubois. Estimated cost, $5,000.

Montreal, Que.
The following contracts have been let in connection with the addition to the Central Exchange of the Bell Telephone Company:—supply of cut stone, John Quinlan & Compony, 4414 St. Catherine Street, Westmount; metal sash, Metal Shingle & Siding Company, Ltd., 91½ Delorimier Avenue; roofing, McFarlane-Douglass Company, Ltd., 34a Dorchester Street W.; sprinkler system, Rockwood Sprinkler Company of Canada, Ltd., 143 St. Maurice Street; plumbing, general contractors; fireproof floors, Douglas Milligan Company, New Birks Building.

In connection with the emergency hospital which is being built for the Montreal Locomotive Works, Ltd., Longue Pointe, the contract for mill work has been let to I. Allard, 1360 Des Erables Steet, cut stone contract to John Quinlan, 4412 St. Catherine Street, Westmount, and the terazzo flooring to Smith Marble & Construction Company, Ltd., 145 Van Horne Street.

The contract for roofing required in connection with the Grand Stand in course of erection for the Montreal Jockey Club has been let to Douglas Milligan Company, New Birks Building.

Niagara Falls, Ont.
The general contract for the erection of a garage and show room on Bridge Street for M. H. Buckley, 20 Ontario Avenue, has been awarded to Ireland & Dinham, Glenholm Avenue, ond the contract for tar roofing to the H. W. Johns-Manville Company, 19 Front Street, Toronto. Approximate cost, $6,000.

Peterboro, Ont.
The Quaker Oats Company, 34 Hunter Street, have awarded the general contract for an addition to their premises to the Canadion Leonard Construction, Post Office Box 919, Peterboro. Brick construction. Approximate cost, $50,000.

Quebec, Que.
In connection with the factory now being built for J. B. Laliberte, 145 St. Joseph Street, the contract for roofing has been let to N. Barbeau, 36 Bridge Street, and the heating, plumbing and electrical work to Jobin & Paquet, 78 Abraham Hill.

The general contract for the erection of a theatre at St. Valier and Carillon Streets has been awarded to M. Cauchon, 309 Richardson Street, and work has been started. Brick and concrete construction. Approximate cost, $15,000.

Renfrew, Ont.
The Renfrew Machinery Company, Ltd., have let the general contract for the erection of a factory to the Renfrew Manufacturing Company. Brick and frame construction. Estimated cost, $8,000.

Sandwich, Ont.
In connection with additions to the premises of the Canadian Salt Company, Ltd., Windsor, the roofing has been let to Welch Brothers, 40 Sandwich Street, Windsor, and the masonry, carpentry and steel work to the general contractors. Electrical work by owners.

Toronto, Ont.
In connection with the factory now in course of erection for William Neilson Ltd., 277 Gladstone Avenue, the carpentry contract has been let to J. D. Young & Son, 835 College Street.

Charles Hough, 906 Broadview Avenue, has been awarded the general contract for the erection of a block of stores and apartments for A. M. Hough, 1666 Queen Street W. Tenders are being received for heating, plumbing, plastering, painting, roofing and electric wiring. Approximate cost, $6,000.

The contract for masonry required in alterations and additions to a building at York and Pearl Streets for the Central Press Agency has been let to Smallwood Brothers, 97 Clinton Street, the carpentry to Cox & Cummings, Canada Life Building, heating to Bennett & Wright, Queen Street E., and roofing to Feather & Roddhouse, 11 Foster Place. Approximate cost $10,000.

Waterloo, Ont.
The generol, masonry, carpentry, steel work, roofing and plastering contracts for the erection of an office building for the Waterloo Mutual Fire Insurance Company have been awarded to Casper Brown, 295 King Street W., Berlin. Previously reported under the head of St. Cathearines.

Windsor, Ont.
Work has been started on the erection of stores and flats on Church Street for D. M. Kemp, and the contract for masonry has been let to Thompson Brothers, Chatham Street W. Brick and concrete construction. Approximate cost, $6,500.

Residences

Avon Head, Ont.
Ezra Lantz, Stratford, Ont., is preparing plans of a residence, to cost about $3,200. Brick and concrete construction.

Belleville, Ont.
Daniel Doyle is considering the erection of two residences on Charles Street, at an approximate cost of $4,000. Brick construction.

Coatsworth, Ont.
Robert McKay, Jasperson Farm, has commenced the erection of a residence, estimated to cost $3,500. Brick and concrete construction.

Cottam, Ont.
Richard Wigle proposes to build a residence at an approximate cost of $3,500, and has prepared plans. Frame and white brick construction.

Hamilton, Ont.
Plans have been drawn for two residences to be built on Balmoral Avenue by C. G. Hudson, 10 Edinburgh Street Brick and concrete construction. Approximate cost, $4,800.

Plans have been drawn for two residences to be built on Balmoral Avenue by D. G. Hudson, 10 Edinburgh Street, and for another to be erected on Rosslyn Avenue. Approximate total cost, $7,800. Brick and concrete construction.

J. M. Cummings, c/o Balmoral Hotel, proposes to build a residence on Main Street, and has drawn plans. Brick and stone construction. Estimated cost, $4,000.

Listowel, Ont.
A. W. Zurbrigg has prepared plans for a residence to be built on Elma Street at an approximate cost of $3,200. Brick and concrete construction.

London, Ont.
The Congregation of the Church of the Redeemer are considering the erection

(Continued on page 51)

Tenders and For Sale Department

Concrete Bridge

Sealed tenders will be received by the undersigned up to **Monday, May 8th, at 6 p.m.**, or at the letting at Elmira on **Tuesday, May 9th**, at 1 p.m., for building a 35 ft. concrete bridge near Wallenstein, between the Counties of Waterloo and Wellington. For plans, etc., apply to

BOWMAN & CONNOR,
31 Queen Street West, Toronto, or
18-18 Berlin, Ont.

Tenders Wanted

Sealed tenders will be received by W. R. Smith, Town Clerk, Ingersoll, up to 8 p.m., **May 8th**, for re-flooring and paving Thames Street Bridge with creosote blocks. Plans and specifications with Town Clerk.

J. HOLLAND,
18-18 Town Engineer.

Notice to Contractors

Pretoria Ave. Bridge

Sealed tenders addressed to the Chairman and Members of the Board of Control will be received by the Secretary of the Board of Control, City Hall, Ottawa, up to 4 p.m., **Tuesday, May 16th, 1916**, endorsed "Tender for Superstructure for Pretoria Avenue Bridge."

Plans, specifications and full particulars may be obtained on application to the City Engineer's Office on a deposit of $50, same being returnable when plans are returned in good condition to the City Engineer's Department.

Any tender received after the above stated time will be declared informal.

The Corporation does not bind itself to accept the lowest or any tender.

F. C. ASKWITH,
Acting City Engineer.
Ottawa, April 28th, 1916. 18-18

Tenders for Cottage

Bulk tenders only for all trades required in connection with work on the erection of Cottage No. 1, Women's Industrial Farm, near Concord, Ont., will be received by registered post only, addressed to the undersigned, up to noon on **Tuesday, May 9th, 1916**.

Plans and specifications may be seen and forms of tender and all information obtained at the office of the City Architect, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. The usual conditions relating to tendering as prescribed by the City By-laws must be strictly complied with or tenders may not be entertained. Tenderers shall submit with their tender the names of two personal sureties or the bond of a Guarantee Company approved by the City Treasurer. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
18-18 Chairman of Board of Control.

CITY OF LONDON, ONTARIO

Storm Sewers and Sewage Disposal Works

Sealed tenders addressed to the "Chairman and Members Board of Control" will be received at the office of the City Clerk until 10 A. M., Friday, **May 12th, 1916**, for the following works:—

Contract 1—Wharncliffe, etc.	2,300 Lin. ft.
Contract 2—Victoria, etc.	6,000 " "
Contract 3—Waterloo, etc.	4,400 " "
Contract 4—Elizabeth, etc.	3,000 " "
Contract 5—Quebec, etc.	2,400 " "
Contract 6—East End Sewage Disposal Works.	

Specifications, forms of tender, plans, profiles, etc., may be seen at the City Hall, London, or at Room 204 Mail Bldg., Toronto, after May 1st, 1916.

Each tender is to be accompanied by a marked cheque as called for in the Instructions to Bidders.

The lowest or any tender not necessarily accepted.

H. A. STEVENSON, Esq., Mayor.

H. A. BRAZIER, Esq., City Engineer.

CHIPMAN & POWER, Consulting Engineers.
April 24th, 1916. 17-18

WANTED
THEW STEAM SHOVEL

Will rent for six or eight months, with option of purchase, one Thew Steam Shovel, size No. 0 preferred. Shovel must be in good condition. Reply at once,

The Hamilton & Toronto Sewer Pipe Co., Ltd.,
18-18 Hamilton and Toronto.

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

AGENTS WANTED

Canadian sales agents wanted for best line of excavating outfits made in the United States. Apply Box 393 "Contract Record & Engineering Review," Toronto, Ont. 17-19

Engineer wants agencies for Montreal and district, side line or specialties, on commission basis. Engineer, Contract Record, 119 Board of Trade, Montreal. 18-18

Late News Items

Alberta Province
The Alberta Farmers Co-operative Elevator Company, Limited, Lougheed Building, Calgary, have awarded the contract for the erection of seven elevators to Thomas-Jamieson-McKenzie, Limited, 301 Travis Building, Calgary, and will build seven others themselves.

Cap Madeleine, Que.
The pulp and paper mills to be built here are for the St. Maurice Paper Company, 524 Board of Trade Building, Montreal. Previous report in error.

Guelph, Ont.
The City Council have awarded the contract for supply of vitrified sewer pipe during the year to Gowdy Brothers, Garden Street.

Halifax, N.S.
The School Board, Sackville Street, will receive tenders until May 15th for the erection of a school on Young St. Architect, W. J. Busch, 60 Bedford Row. Approximate cost, $75,000. Granite, reinforced concrete and pressed brick construction.

Maisonneuve, Que.
The Deakin Construction Company, Sommer Building, Montreal, have been awarded the general contract for the erection of the Orleans Theatre for the Maisonneuve Amusement Company, Limited, 688 Notre Dame Street E. Terra cotta, steel and pressed brick construction.

Raoul Gariepy, Architect, 25 St. James Street, will receive tenders until May 15th for the erection of a picture theatre for the Theatre Maisonneuve Ltd. Steel and concrete construction, seating capacity 1,00.

Montreal, Que.
Fire has destroyed a drying house owned by J. Therrien. Loss, about $8,000.

Daniel Blay, 302 Clifton Street, is about to start work on four flats, estimated to cost $7,000. Brick and concrete construction.

Saskatoon, Sask.
J. H. Ashdown, 529 Wellington Crescent, Winnipeg, has purchased a site on Second Avenue for a picture theatre, to cost about $50,000.

St. George, Que.
Work is about to start on the erection of a store for J. Gagnon, estimated to cost $10,000. Tenders will not be called. Architects, Berube & Frere, St. George, Que. Brick and frame construction.

Toronto, Ont.
R. D. Kilgour, 45 Willcocks Street, has had plans drawn for a residence to be erected at High Park Gardens. Brick construction. Approximate cost, $12,000.

J. F. Alexander, 8 Temple Avenue, has commenced the erection of a duplex residence, estimated to cost $7,000. Brick construction.

C. E. Tyler, 85 Cumberland Street, has started work on a residence at 71 Forest Hill Road, and will let smaller trades about the end of the month. Brick construction. Approximate cost, $7,500.

E. Taylor, 162 Delaware Avenue, has commenced the erection of apartments at 29 Breadalbane Street, estimated to cost $15,000. Brick and stone construction.

Residences

(Continued from page 49)

of a Rectory. Pastor, Rev. H. B. Ashby, 914 William Street.

Middleton, N. S.
A. P. Dodge is considering the erection of a double tenement, at an approxmiate cost of $3,000. Concrete block construction.

New Glasgow, N.S.
W. H. George, Castle Building, Queen Street, Ottawa, is preparing plans of a residence for J. H. St. Claire, M.P., New Glasgow, and will call for tenders shortly. Brick and stone construction. Approximate cost, $11,000.

Niagara Falls, Ont.
Simon Larke, Main Street, Niagara Falls, N.Y., is preparing plans of a residence to be built for Albert Walterhouse, Morrison Street. Approximate cost, $4,500.

Northampton, N.B.
H. H. Smalley is building a bungalow by day labor. Estimated cost, $3,00.

Ottawa, Ont.
A. E. Shaver, 45 Powell Avenue, is preparing plans of a residence to be built on Findlay Street at a cost of about $6,500. Brick, stucco and stone construction.

T. J. Somerville, 28 Waverdley Street, has had plans drawn for two double residences to be built at an approximate cost of $7,000. Brick veneer and stone construction.

A. Levinson, 96 Blackburn Avenue, is considering the erection of a residence on Murray Street, to cost about $5,000. Brick veneer construction.

The erection of a residence is being considered by A. E. Thomas, 155 Sunnyside Avenue. Estimated cost, $4,500. Brick veneer construction.

Plans have been prepared for two residences to be built for A. E. Shaver, 45 Powell Avenue, at an approximate cost of $3,500 each. Stucco and brick veneer construction.

E. L. Parent, 387 Booth Street, is about to commence alterations to a residence, estimated to cost $3,000. Brick veneer and concrete construction.

Robert Christie, 152 Bell Street, has prepared plans for a residence to be built on Sunnyside Avenue at an approximate cost of $4,000. Double brick veneer construction.

A. E. Shaver, 45 Powell Avenue, has drawn plans for a residence to be built on Broadway at an approximate cost of $6,000. Stucco and brick veneer construction.

Paisley, Ont.
J. A. McArthur is preparing plans of a residence to be built on Queen Street, at an approximate cost of $3,500. White brick and concrete construction.

Quebec, Que.
P. Villeneuve, 241 Prince Edward St., contemplates the erection of a residence, and will prepare plans. Estimated cost, $6,000. Brick, stone and concrete construction.

Felix DeLisle, 129 Hermine Street, has commenced the erection of an addition to his residence. Estimated cost, $3,500.

Work has been started by Wilfrid Legare, 3 d'Argenson Street, on the erection of a residence, estimated to cost $4,000. Brick, frame and concrete construction.

Jules Dorion, 139 Fifth Street, has commenced the erection of a residence on Third Avenue, Limoilou, estimated to cost $3,000. Brick construction.

E. Rochette, Bourlamarque Avenue, has started work on a residence, estimated to cost $6,000. Brick and concrete construction.

Sarnia, Ont.
E. E. Corey, 203 Brock Street S., will shortly start work on four residences on Campbell Street. Frame and concrete construction. Estimated cost, $5,000.

St. Catharines, Ont.
A. E. Nicholson, architect, Queen St., will receive tenders until May 8th for the erection of a residence for A. H. Wallace, 97 St. Paul Street. Estimated cost, $10,000.

St. Remi D'Amherst, Que.
Paul Thomas proposes to erect a residence at a cost of about $3,000.

Stayner, Ont.
Tenders will be received until May 8th for the erection of a residence for T. A. McDonald. Architect, John Wilson, Collingwood, Ont. Brick construction.

Toronto, Ont.
Plans have been drawn for a pair of residences to be erected on Gillard Avenue by J. R. Gifford, 190 Pape Avenue. Brick construction. Approximate cost, $4,200.

H. D. Lang, 605 Traders Bank Building, has commenced the erection of a pair of residences on Keewatin Avenue, estimated to cost $10,000. Brick construction. Various trades will be let.

C. Caldwell, 583 Carlaw Avenue, is building a pair of residences on Kent St. Brick construction. Estimated cost $6,000.

Plans have been prepared for a residence to be built on Westmount Street by W. Colwell, 179 Delaware Avenue. Smaller trades will be let. Brick construction. Approximate cost, $3,500.

The City Home Limited, care of G. H. McLaughlin, 48 Hogarth Avenue, have commenced the erection of a pair of residences estimated to cost $5,000. Smaller trades will be let. Brick construction.

A. Milne, 66 Lamb Avenue, has commenced the erection of a residence, estimated to cost $3,200. Smaller trades will be let. Brick construction.

Work has been started by J. Meldrum, 213 Quebec Avenue, on the erection of a residence, estimated to cost $3,000. Smaller trades will be let. Brick construction.

F. Samlow, 3 Muir Avenue, proposes to build a pair of residences on St. Helena Avenue, and has had plans drawn. Brick construction. Approximate cost, $3,600.

N. Mills, 349 Palmerston Boulevard, has commenced the erection of a residence on Ward's Island. Frame construction. Approximate cost, $4,000.

J. Carlisle, 36 Pacific Avenue, has commenced the erection of a residence on Evelyn Crescent, estimated to cost $3,200. Smaller trades will be let. Brick construction.

N. Hicks, 612 Delaware Avenue, is building two pairs of residences estimated to cost $12,000, and will let smaller trades. Brick construction.

Plans have been prepared for three residences to be built by Cox & Cummings, 2118 Queen Street E. Brick construction. Approximate cost, $6,600.

Westmount, Que.
J. Sawyer, 407 Guy Street, has prepared plans of a residence for the Christian Brothers, 360 Clark Avenue. Brick and concrete construction.

Windsor, Ont.
J. C. Pennington, La Belle Building, has plans in hand for a block of four family flats to be built on Sandwich St., at an approximate cost of $10,000. Brick veneer and concrete construction.

S. C. Robinson, Devonshire Road, Walkerville, is having a bungalow built on Dougal Avenue by day labor under supervision of R. Wescott, 55 Oak Avenue. Frame and concrete construction. Approximate cost, $3,500.

CONTRACTS AWARDED

Belmont, Ont.
The general contract for the erection of a brick bungalow for A. W. Beattie has been let to Turner Brothers, Belmont. Approximate cost, $5,000.

Gananoque, Ont.
The general contract for the erection of a residence for Richard Johnston has been let to Mitchell & Wilson, Market Street. Brick construction. Approximate cost, $3,000.

Gosfield Township, Ont.
The general contract for the erection of a residence for W. Jackson, Concession 8, has been awarded to Joseph A. Jackson, Cottam. Brick veneer construction. Approximate cost, $3,000.

Hamilton, Ont.
C. H. McKay, Lister Building, has let the general, masonry, carpentry and roofing contracts for the erection of a residence to McKay Brothers, Lister Building. Brick and concrete construction. Approximate cost, $3,000.

Work has been started on a residence for E. A. Mark, 8 John Street N. The general contract, masonry, carpentry, steel work and roofing have been awarded to G. E. Mills, King Street E. Estimated cost, $5,000.

W. J. Whitfield, 224 Main Street E., has let the general contract, masonry, carpentry and roofing for alterations to a residence to J. J. Giles, 124 Grant Avenue. Approximate cost, $3,000.

E. A. Seymour, 65 Fairholt Road, is building three residences on Cumberland Avenue for F. McNiven. The contract for heating and plumbing has been let to P. A. Moore, 939 King Street E. Approximate cost, $2,000 each.

The general contracts, masonry, carpentry and roofing for the erection of two residences for J. F. Bethune, 57 St. Clair Avenue, have been awarded to James McNaught, 177 Wilson Street. Approximate cost, $3,600.

Kingston, Ont.
The general contract for the erection of a residence for Samuel Green, 74 Brock Street, has been let to Douglas & McIlguham, 510 Brock Street. Brick and stone construction. Approximate cost, $5,000.

London, Ont.
The general contract for the erection

of a residence for Mrs. F. C. Vrooman, 21 Askin Street, has been let to S. Stinchcombe, Pipe Line Road, and work has been started. White brick and concrete construction. Approximate cost, $3,000.

Middlemiss, Ont.

W. Saunders, Dutton, Ont., has been awarded the general contract for the erection of a residence for Alexander Battin, Middlemiss, and will shortly start work. Brick and concrete construction. Estimated cost, $3,000.

Montreal, Que.

The contract for roofing required in the erection of a residence for D. C. G. Higginson, 3435 Park Avenue, has been let to Campbell, Gilday Company, 793 St. Paul Street, and the electrical work to Electric Repair & Contracting Company, Limited, 317 Craig Street West. Remainder of work by general contractors.

The contract for roofing required in the erection of a residence for E. W. Herring, 2 McGill College Avenue, has been awarded to Campbell, Gilday Company, 793 St. Paul Street W., and the electrical work to the Electric Repair & Contracting Company, Limited, 317 Craig Street W.

J. C. Perron, 669 Querbes Street, has commenced the erection of a residence and garage, and has let the contract for foundations and masonry to F. X. Cusson, 2200 St. Lawrence Boulevard, the carpentry to J. B. Beaumont, 2480 Waverley Street, brick work to S. Rochon, 470 Outremont Avenue, and roofing, heating and plumbing to J. E. Blanchard & Son, 2168 St. Lawrence Boulevard.

Mrs. C. M. Hays, 694 Mountain St., has awarded the general contract for the erection of a residence and garage to J. H. Huntchison, 64 St. Antoine St. Brick and concrete construction. Approximate cost, $5,000.

Montreal West, Que.

The general contract for the erection of a residence for J. A. Elder, 108 Strathearn Avenue, has been let to W. H. Payne & Company, 62 Westminster Avenue N. Estimated cost, $5,000.

Ottawa, Ont.

C. Sutherland, 460 McLeod Street, has let the contract for masonry required in the erection of a residence on Carling Street to Beattie & Davidson, Renfrew Avenue. Other contracts will be let later. Approximate cost, $7,500.

J. Y. Caldwell, Kirchofter Avenue, has commenced the erection of two residences on Carleton Avenue, and has awarded the contract for electrical work to P. Ackroyd, 416 Bank Street. Estimated cost, $3,500 each.

Quebec, Que.

The general contract for the erection of a residence for Lucien Gaboury, 404 St. Valier Street, has been let to V. R. La Montagne, Quebec Railway Building. Brick construction. Approximate cost, $4,00.

The contract for roofing, heating, plumbing and electrical work required in the erection of a residence for Mde. H. R. Dussault, 163 Fifth Street, has been let to A. Lapointe, 74 Sixth Avenue, Limoilou.

N. Jobidon, 110 Fifth Street, has commenced the erection of a residence for Robert Jobidon. Brick construction. Approximate cost, $8,00. Tenders on roofing, plumbing and electrical work are now being received by the owner.

St. Marys, Ont.

Frank H. Smith has awarded the general contract for the erection of a residence on James Street to W. Heuther, the carpentry to Stafford & Henderson, Queen Street W., plastering to C. Hammond, painting to F. Willard, Water Street N., and heating and plumbing to Cline & Wellington Steet. Approximate cost, $4,000.

Toronto, Ont.

The contract for masonry required in the erection of a residence for Mrs. O. G. Palm, 133 Roxboro Street E., has been awarded to Gordon Brothers, 1 Delisle Avenue, and the carpentry to Madden Brothers, 552 Adelaide Street W. Estimated cost, $14,000.

James Allan, 30 Castlefield Avenue, has been awarded the general contract for the erection of a residence for T. A. Gibson, 423 Walmer Road, and will let smaller trades. Estimated cost, $6,500.

Roberts Brothers, 241 Dovercourt Road, have commenced the erection of apartments ,estimated to cost $50,000, and have let the contract for excavation to E. Corner, 698 Manning Avenue. Brick and stone construction.

Walkerville, Ont.

. In connection with the residence in course of erection for F. E. Allum, Detroit, Mich., the carpentry has been awarded to the general contractor, plumbing to R. Hicks, 159 Wyandotte Street E., heating to J. E. Purser, 30 Glengarry Avenue, and electrical work to Gilbert Campeau, 121 Tuscarora Street.

Windsor, Ont.

The contract for plumbing required in the erection of a flat for Mrs. T. Hallett, 1 Dougal Avenue, has been let to Fletcher & Jones, Windsor Avenue, and the electrical work to W. Lefave, 235 Bruce Avenue.

Power Plants, Electricity and Telephones

Brooke Township, Ont.

The Township Council intend to petition for the installation of a hydro-electric system. Clerk, W. J. Weed, Inwood, Ont.

Edmonton, Alta.

The Provincial Legislature have ratified the agreement between the Edmonton Power Company, c|o G. W. Farrell & Company, 43 St. Fancois Xavier Street, Montreal, and the City Council for the supply of power for 21 years. The project includes the construction of a large dam, power houses and electric railway. The contract for dam and power house may be let to Sir John Jackson, Ltd., London, England. Approximate cost, $6,000,000.

Enniskillen Township, Ont.

The Township Council propose to secure estimates on the cost of a light and power system. Clerk, G. V. Wyant, Petrolia.

Ingersoll, Ont.

The Town Council are considering the installation of an ornamental lighting system on the paved streets. Clerk, W. R. Smith.

Kingston, Ont.

The City Council are having plans prepared for electric lighting at Barriefield Camp. Clerk, W. W. Sands.

St. Francois de Beauce, Que.

The Beauceville Telephone Company propose to construct a system at an approximate cost of $10,000. Secretary, A. Doyon.

CONTRACTS AWARDED

Amherstburg, Ont.

The Town Council have let the contract for the installation of a street lighting system to the Ontario Hydro Commission, Toronto, and work will be done under supervision of the Commission's Engineers. Approximate cost, $5,000.

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Principal Contents

Should Engineering Societies Pass On Public Questions?

A short time ago a reinforced-concrete structure was being built in a certain city under the supervision of that city's engineer. Rerolled steel, employed as the reinforcing material, was objected to by one of the city aldermen, who brought the matter to the notice of the council. The city engineer was asked to explain. The argument fast degenerated to the see-saw order, and a deadlock resulted. The papers then took a lively interest in the matter, and last of all that Colossus of astute intelligence—the man-in-the-street—began to furbish up some of the minor parts of his subconscious stratum.

When a deadlock is established in a controversy, one of the contending parties is very apt to undertake hasty action. Otherwise, complete collapse results. In this particular case the council, instead of taking the matter in hand and obtaining a report on the dispute by some competent person, collapsed.

What next happened was to the writer incomprehensible. An engineering society, uninvited, informed the council that it would be pleased to go into the matter, its services to be given free. The old adage, "Beware of entering into a quarrel," etc., had no terrors for the society. It did not occur to the members that they were exposing themselves to a rebuff in case the council awakened to a sense of its responsibility and again took the matter into its own hands.

* * *

This incident brings up the question—Have our engineering societies the right to assume the role of adjudicator on all subjects of an engineering nature? The writer wishes, if possible, to ascertain on what authority some individuals have assumed to pass upon engineering matters and then branded their findings with the name of an engineering society. In looking through the constitutions of engineering societies it is difficult to find any laws or rules that clothe the members with judicial authority. Neither has the writer ever heard of any unwritten law or custom bearing on the subject. From this he concludes that the members of our societies never intended that their names should be used in public investigations such as that just cited.

No matter how high sounding our societies' titles may be, we should never lose sight of the fact that these associations are composed of fallible men. Our societies generally recognize this fact, and for this reason they have not included in their plan of organization any provision for investigations of a public nature. As an illustration of the statement that engineering societies are composed of fallible men, the writer asked one of the executive of the society that proposed the investigation referred to what his views were on the subject. This gentleman said that he did not care two straws whether any reinforcing was used in the structure or not! This statement is analogous to that of a baker who informs you that he can make currant bread without currants.

* * *

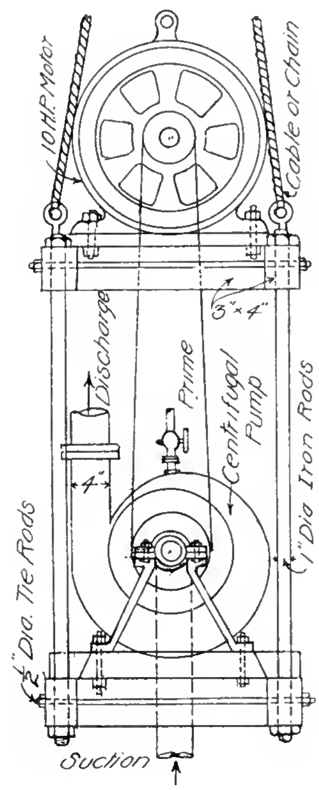
When a society intrudes in such a manner, we naturally ask ourselves,—What is this being done for? It is said that there is never a good action done but that there is a small grain of bad in it. The truth of this saying can be seen on a moment's reflection. Did the society offer its services with the intention of placing its decision in the category of "no higher appeal," or was there some extraneous consideration?

If the intention was to place the finding of the society above the opinion of the individual, then the society is curtailing the freedom of the profession. If the intention was to allay the public's fear concerning the material under discussion and if the finding was given with respect to this, then the interference of the society was most harmful. Such a decision would have an influence not measured by the engineering ability of the investigators at all, but measured solely by the good or bad judgment of the men composing the committee. Nevertheless, the committee's decision, being announced as an action of the society, would have with the public a weight that it otherwise would not have. If engineering societies are going to interfere when and where they think proper, what will be the state of mind of the private practitioner? He will never know when he may be brought to account.

Engineering has long passed the stage of mere algebraic formulas. We are no longer dealing only with the x's and the y's; other elements, often very difficult to estimate, have entered into the calculation. They may take the form of expediency or they may be cost figures or they may come under some other head. These other elements have under present conditions a strong influence on our engineering calculations. They are often the controlling considerations. In other words, they are functions of our engineering problem and will often determine the success or failure of a scheme. Our engineering societies, judging from their constitutions, are not concerned with anything outside engineering science, so the harmonizing of this science with general advancement should be left with the private practitioner. For these reasons the writer believes that our societies should not take upon themselves the role of "courts of appeal."—Hugh J. Duffield, in Engineering News.

Electricity and Construction Work

The utilization of electricity in sewer construction and foundation work has reached an advanced stage in Canada and the United States. In addition to pumping purposes, electric motors are used in connection with travelling cranes, for operating air compressors for use in driving, riveting, steel piling, etc.,



A Typical Example of the many uses to which Electricity can be put.

for electric shovels, for excavating, on gantries used in laying concrete pipe, and other numerous duties. Soil excavated is removed by trucks drawn by electric locomotives, and the necessary materials, tools, etc., are conveyed to the work by the same means; they also provide transportation for workmen.

The reduced cost of hydro-electric power in Canada and the United States has done much to promote the use of electricity for power purposes on construction work. Besides, there can be little doubt that from the point of view of convenience and ease of handling, electricity is superior to the old-fashioned methods even at present employed by some of our contractors.

The accompanying illustration is a typical example of the many uses to which electricity is now put. It shows the adoption of an electric motor in keeping caissons and foundation excavations free from water. The apparatus consists of a 4-in. centrifugal pump, mounted on a heavy steel and wood frame, belt-connected to a 10-h.p. electric motor. The motor is bolted to the top of the frame about 6 feet above the pump to eliminate any danger from water striking the motor and destroying the insulation, thereby injuring the motor. The whole unit is suspended by heavy chains from a crane or derrick or some adjustable means of support above the excavation, and can be placed at any desired depth or position in the trench. This makes it exceedingly effective for this kind of work.

Committe to Supervise

Under a by-law which has received its first reading, the city of Westmount will appoint a committee to supervise the construction of all buildings and all alterations. The committee will be composed of the mayor, the general manager and the engineer of the city, all ex-officio, four architects, and any other persons that the council may appoint from time to time. Each member of the committee will act without any remuneration. Several architects have already offered their services. All plans and specifications will have to be submitted to the committee, and a decision is to be made within seven days. If an alteration is suggested by the committee, a decision may be postponed beyond the period of seven days, but this postponement is subject to the agreement of the applicant. An appeal to the council may be made from the decision of the committee. The by-law does not dispense with the necessity of obtaining the usual permit. Infringement of the by-law renders any person liable to a fine of $40 for the first offence. Four members, two of whom must be architects, form a quorum.

Pan-American Road Congress

The proceedings of the Pan-American Road Congress have just come to hand. The congress was held under the joint auspices of the American Road Builders' Association, the American Highway Association, with the co-operation of the Pacific Highway Association, at Oakland, Cal., September 13, 14, 15, 16 and 17, 1915.

The proceedings, which covered ten sessions—two each day, included all addresses, reports, etc., besides papers and discussions on 27 subjects covering the various factors involved in road and street administration, construction and maintenance, delivered by men prominent in their special branches. The proceedings, which cover 416 pages 6 in. x 9 in., are paper bound and are on sale by the executive committee of the Pan-American Road Conference, 150 Nassau Street, New York, for $2.00.

The Standard Underground Cable Co. of Canada, Limited, announce that their Montreal branch office is now located in the McGill Building instead of the New Birks Building as heretofore.

New Steel-Arch Bridge at St. John, N.B.

To Replace Old Suspension Bridge Over Gorge at the Reversible Falls—Span 565 Feet—Deck 50 Feet Wide

DUE to the increasing density and volume of traffic, the old suspension bridge over the St. John River at the Reversible Falls, St. John, N. B., had become inadequate and the provincial government of New Brunswick, to meet the increasing demand, has built a new long-span steel arch bridge. The new bridge is one of unusual interest, ranking, with its 565 ft. span, among the first half dozen of America's long-span steel bridges. It is a street crossing to take the place of the old suspension bridge which was built in 1852 by William K. Reynolds on the design of Edward Serrell, on almost the same location. The late C. C. Schneider, Philadelphia, recently a member of the Quebec Bridge Commission, was retained as consulting engineer on the new bridge, and with his associate, F. S. Kunz, designed a steel spandrel-braced arch spanning the rock gorge. The width and height of the gorge are such as to make the arch of unusually flat proportions. The span is 565 feet. The ratio of rise to span is 1 to 9.2. In due proportion, the crown depth is small, 8 ft. 6 in., while the depth at the end post (set 2½ ft. forward of the skewback hinge) is 60 ft. 3 in. The top chord and roadway have an initial grade of 3.215 per cent. The arches are set in vertical planes.

The truss spacing is 41 ft., for a 50-ft. deck, comprising 36-ft. roadway and two 7-ft. sidewalks. The curbs are thus set a short distance in from the inner face of the top chord, and the sidewalk bracket outside the top chord is correspondingly shortened. The panel length is 23 ft. 4 in. uniformly (24 panels).

The structure is of thoroughly modern highway-bridge character as regards detail. This means heavy solid floor and large live-load capacity. The floor is a 6-in. reinforced-concrete slab on I-beam stringers, with a surfacing of 4-in. creosoted wood block. The sidewalks are 4½-in. slabs surfaced with ½-in. cement mortar. Two trolley tracks occupy the middle of the roadway. The bridge also carries an 18-in. cast-iron water main.

The dead-loads are summarized by the following tabulation for the completed condition and for erection conditions respectively:

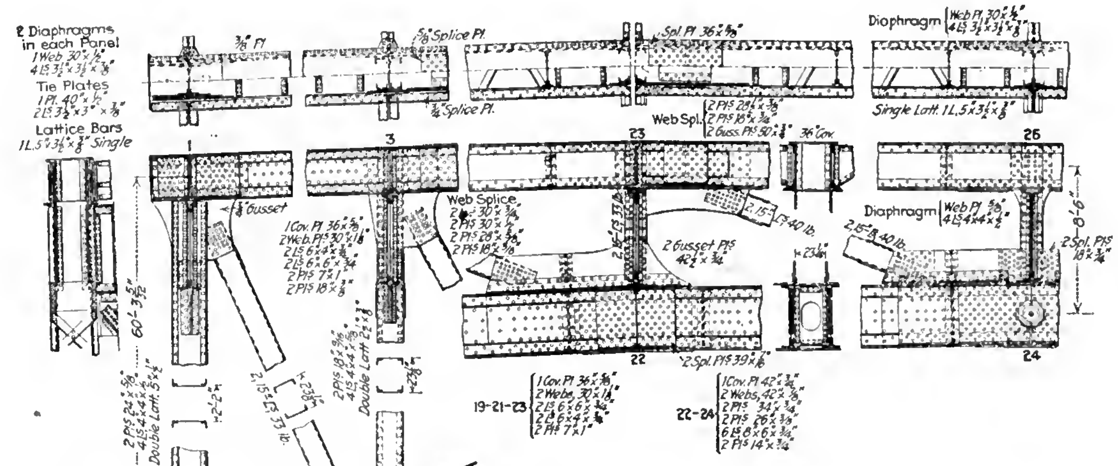
Dead-Load of St. John Arch

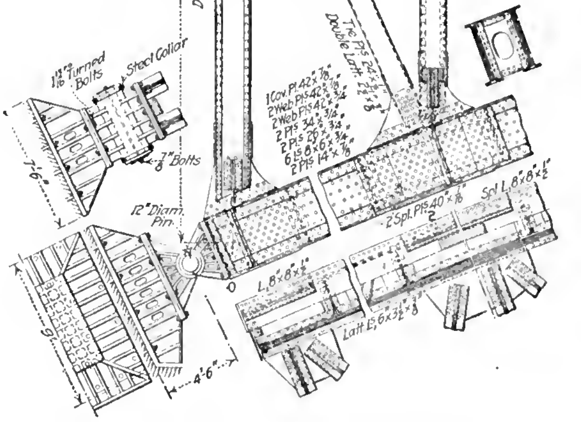
(In lb. per lin. ft. of bridge)

After completion:	
Flooring, rails, water pipe, etc.	5,100
Floor system	1,300
Trusses and bracing, average	5,600
Total, average	12,000
Maximum during erection:	
Stringers, floor-beams and rails	700
Trusses and bracing, average	5,600
Total, average	6,300

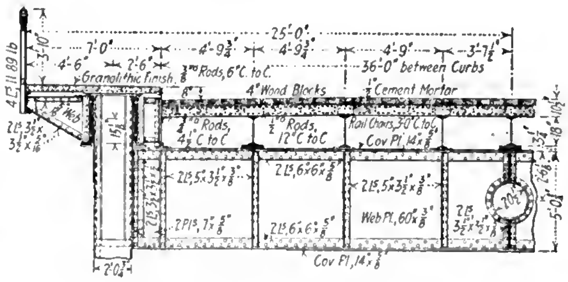
The average loads given were not used in the calculations, but the actual panel concentrations were

Fig. 1—Erection of Steel-arch Bridge in centre, Suspension Bridge to left since Removed.

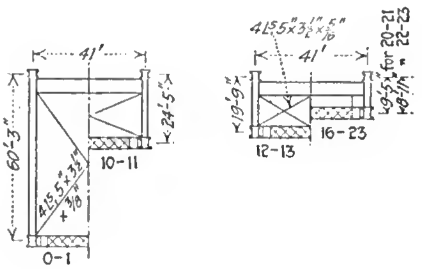




TYPICAL DETAILS OF ARCH



HALF CROSS-SECTION



TYPICAL SECTIONS

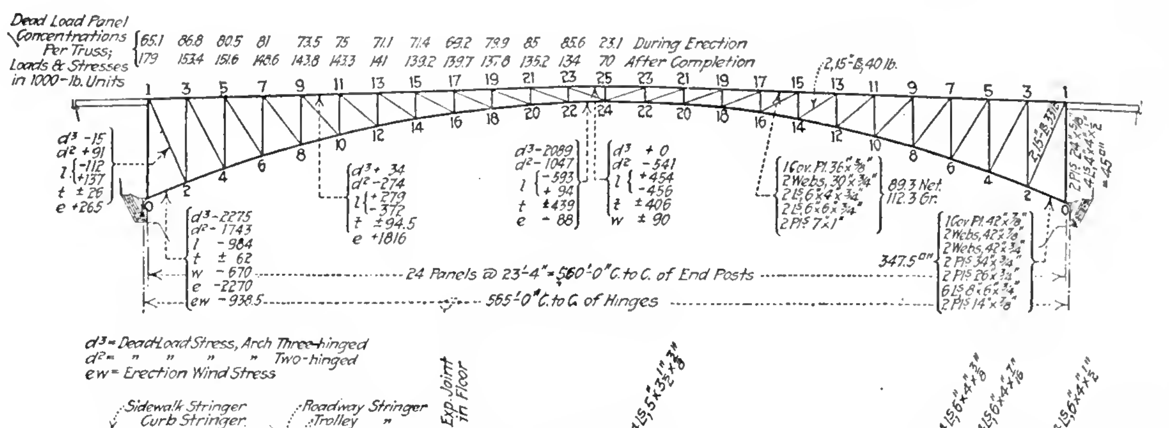
Live-Load Specifications

For roadway stringers, one 20-ton road roller.

For trolley stringers and floor-beams, on each track two 8-wheel 40-ton cars end to end, plus 25% impact.

For sidewalks, 100 lb. per sq.ft.

For main trusses, 3,000 lb. per lin.ft. of bridge. This represents 60 lb. per sq.ft. over the whole area between railings, or else 40-ton 40-ft. trolley cars on each track spaced 40 ft. in the clear on both tracks, and 36 lb. per sq.ft. on all other floor surface.



OUTLINE SKETCH OF REVERSIBLE FALLS ARCH, WITH LOADS AND TYPICAL STRESSES

Fig. 2—Bridge Details of Steel-Arch Bridge at St. John, N. B.

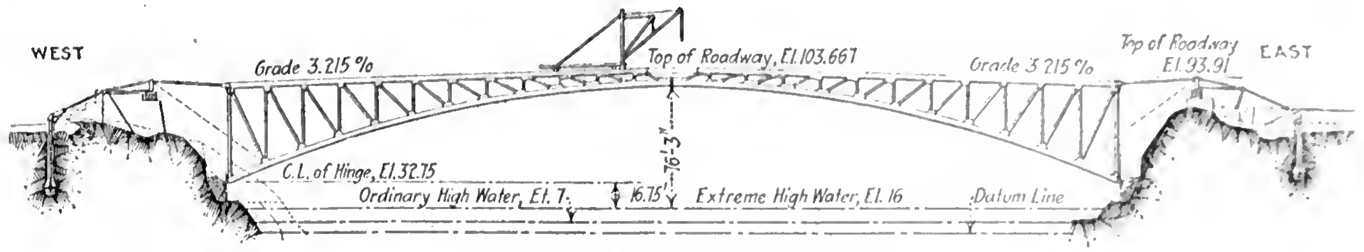


Fig. 3—Erection Sketch of Reversible Falls Steel Arch.

taken. A traveller load of 75 tons was taken into account in computing erection stresses.

The live-load was graded for the design of the different structural parts from stringers to main trusses. The specifications for live-load are given in the bridge details shown.

Method of Erection

The trusses were erected without falsework, by the usual cantilever method. The arrangement of anchorage and adjusting toggles for the erection and closure is shown by the sketch, Fig. 3.

Closure was made by inserting the top chord mem-

Fig 4—View showing the Cantilever Railway Bridge, New Steel Arch and Suspension Bridge at St. John, N. B.

ber without stress, after lowering the half trusses to contact on a pin at the centre bottom-chord joint. The bridge is thus three-hinged for the erection dead-load, but is two-hinged for live-load and temperature.

The main span is flanked by two 46-ft. 8-in. deck plate-girder spans. The total length of steel superstructure is 654 ft. between back walls.

The contract for the work was let early in 1913 by the Chief Commissioner of Public Works, John Morrissy, to the Dominion Bridge Company, Montreal. A. R. Wetmore was Provincial Engineer.

It is of interest to note that the cantilever railway bridge near the arch, which can be seen in the photographs, is, like the suspension bridge, a historic structure. It was erected in 1884, just after Mr. Schneider's Niagara (Michigan Central) cantilever, and thus was among the first three or four of modern cantilevers in America. The Dominion Bridge Company built it. Its main span is 477 feet long, containing a 143-ft. suspended span. The suspension bridge, also shown, has since been removed. We are indebted to the Engineering News for the above information.

Mr. R. T. Stull, Ceramic Engineer of the Dunn Wire-Cut Lug Brick Company of Conneaut, Ohio, was elected an honorary member of the Paving Brick Institute at the recent meeting at Portsmouth, Ohio.

Contracts Secured

The London Concrete Machinery Co., Limited, of London, Ont., advise that they have recently secured contracts to supply the following machinery:—

M. A. Congdon, Digby, N.S., with a half yard batch mixer; George Hintz, Bridgeport, Ont., with one quarter yard mixer; Wm. Rosebush, Frankford, Ont., with one 1/6 yard mixer; Robert Lattimer, Strangefield, Ont., with 1/4 yard batch mixer; Lewis & Midgley, Hamilton, Ont., with one quarter yard mixer; Thos. McCormick, Carman, Min., with 1/6 yard mixer; H. V. Gray Construction Co., Merriton, Ont., with a 3/4 yard batch mixer; Ontario Paper Company, Thorold, Ont., with one half yard batch mixer; Arthur Desautels, Crysler, Ont., with a complete plant for making cement sewer pipe and culvert tile; Wright & Company, Hull, Que., with cement drain tile machine, tile cars, etc., to be installed in their new plant; Henry Rebidoux, Amherstburg, Ont., with 1/4 yard batch mixer, also cement drain tile machine and concrete block machine, to be installed in his new concrete plant.

Australian Steel

A notable industrial triumph, marking a new era in the development of the Commonwealth's resources, has been achieved in the manufacture of steel of the highest quality at the works of the Broken Hill Proprietary Company at Newcastle, New South Wales. The steel has been highly tested by representatives of the Imperial Munitions Department, with such successful results that a first order was given to the Company for 500 tons of steel to be shipped during February, for use in the manufacture of munitions in Great Britain.—United Empire.

Daylight Saving Law

The City Council of St. John, N. B., has enacted a by-law putting the Daylight Saving Law in operation in that city from midnight April 30 until the same hour on September 30. St. John is thus the first city in Maritime Canada to adopt Daylight Saving, as it was the first to adopt the commission form of civic government and the town planning system. The provincial legislature will be asked to pass an Act making the daylight saving movement effective throughout the province.

J-M Asbestos Roof

In our description of the Robert Simpson warehouse, which appeared in the April 26 issue of the Contract Record, it was omitted to note that the roofing to be applied on this building is a J-M built-up Asbestos Roofing, being installed by the manufacturers, the Canadian H. W. Johns-Manville Co., Limited.

Developments in Bituminous Roads

Construction Methods in Laying Bitulithic, Warrenite and Topeka—Specifications—Present Status of Patent Litigation

By Arthur H. Blanchard, M.C.S C.E.*

Before proceeding with the discussion of the many improvements in the construction of bituminous macadam and bituminous concrete pavements which have been developed during the period from 1914 to 1916, it is advisable, in order to avoid misunderstandings, to quote the definitions of the two types of pavements as recommended by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers.

"Bituminous Macadam Pavement. One having a wearing course of macadam with the interstices filled by penetration methods with a bituminous binder."

"Bituminous Concrete Pavement. One composed of stone, gravel, sand, shell or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods."

Certain developments which are common to both classes of bituminous pavements will be discussed prior to considering improvements which specifically refer to each of the several types.

Foundations

There has been a general acknowledgment of the ultimate economy of constructing adequate foundations to support the amount and character of traffic which the several types of bituminous pavements are able to carry. In the case of bituminous macadam pavements, this development usually has been characterized by the construction of well compacted and, in many cases, thoroughly filled broken stone foundations. In the case of bituminous concrete pavements, due to numerous failures which have occurred where this type of pavement has been built on old macadam or poorly constructed broken stone foundations, there has been a general tendency to advocate the use of cement-concrete foundations from four to six inches in thickness. It has generally been found that the cost of cement-concrete foundations does not exceed the cost of well compacted and filled broken stone of equivalent strength. Furthermore the use of cement-concrete foundations renders repairs and renewals more satisfactory and much easier of accomplishment.

Non-Bituminous Highway Materials

There has been a general recognition since 1914 of the desirability of covering in specifications in more detail and with greater rigidity the physical properties of the aggregates to be employed and the sizes of the particles which compose such aggregates. For example, the 1914 Specifications of the American Society of Municipal Improvements covering bituminous macadam pavements state, with reference to the physical properties of the stone, that the rock employed must meet the following requirements:

"The broken stone shall be subjected to abrasion tests and toughness tests conducted by the Engineer in accordance with methods adopted by the American Society for Testing Materials, August 15, 1908. The broken stone used for the construction of the first and second courses shall show a French coefficient of wear of not less than 7.0 and its toughness shall be not less than 6.0. The broken stone used for the construction of the third course and for the first and second applications of No. 1 broken stone shall show a French coefficient of wear of not less than 11.0 and its toughness shall not be less than 13.0."

The necessity for more carefully drawn specifications covering the sizes of the particles of which a given product of a stone crushing and screening plant is composed is illustrated by the following mechanical analyses of two products obtained from the same plant, both of which products passed over a section of a rotary screen having circular holes of 1¼ inches and through a section of a rotary screen having circular holes 2¼ inches in diameter.

	Sample "A" Per cent.	Sample "B" Per cent.
Passing ⅛ inch screen	0.2	0.1
Passing ¼ inch screen	0.1	0.1
Passing ½ inch screen	0.4	1.1
Passing ¾ inch screen	2.2	12.6
Passing 1 inch screen	8.0	37.5
Passing 1¼ inch screen	29.1	40.9
Passing 1½ inch screen	27.1	7.7
Passing 2 inch screen	32.9	0.0
	100.0	100.0

It is hence obvious that for many forms of bituminous construction, in order to secure successful results, greater care must be used in the writing of specifications for products of broken stone. As an illustration of an improvement in specifications covering this detail, there is cited those adopted at the 1915 Convention of the American Society of Municipal Improvements covering broken stone to be used for the aggregate of one type of bituminous concrete pavement.

"Broken stone for the mineral aggregate of the wearing course shall consist of one product of a stone crushing and screening plant. It shall conform to the following mechanical analysis, using laboratory screens having circular openings: All of the broken stone shall pass a one and one-quarter (1¼) inch screen; not more than ten (10) per cent. nor less than one (1) per cent. shall be retained upon a one (1) inch screen; not more than ten (10) per cent. nor less than three (3) per cent. shall pass a one-quarter (¼) inch screen."

It is noted that in this form of specification an attempt is made to cover in the mechanical analysis only the limits of the smallest and largest particles. No attempt is made to secure a carefully graded aggregate but simply a product suitable for the type of pavement in question and uniform in character. For example, the following mechanical analyses show three products used in the successful construction of three different bituminous concrete pavements of the type mentioned.

	Sample "A" Per Cent.	Sample "B" Per Cent.	Sample "C" Per Cent.
Passing 1/8 inch screen	1.2	2.7	1.0
Passing ¼ inch screen	4.2	5.6	2.5
Passing ½ inch screen	34.7	45.0	30.8
Passing ¾ inch screen	40.6	35.1	34.2
Passing 1 inch screen	17.3	10.1	23.4
Passing 1¼ inch screen	2.0	1.5	8.1
	100.0	100.0	100.0

There has recently been considerable discussion pertaining to the advisability of the adoption of so-

* Before the Canadian and International Good Roads Congress, Montreal.

called "alternate type" specifications in preference to the so-called "blanket" specifications for bituminous materials. By alternate type specifications is meant a series of specifications, each of which covers the physical and chemical properties of the most desirable grade of a given type of bituminous cement for the purposes for which it is to be used. On the other hand a blanket specification covers in one set of requirements, pertaining to physical and chemical properties, all the types of bituminous cement which are to be used in connection with the construction of a given kind of pavement. For example, in the case of specifications for asphalt cement for bituminous concrete pavements, it would be desirable under alternate type specifications to have not less than five sets of physical and chemical requirements, the limits for each requirement being as narrow as the several processes of manufacture would permit, while on the other hand a blanket specification would cover with a wider range of limits the same chemical and physical properties for the five types mentioned. As an illustration will be cited the limits in the case of Specifications "A" to "E" inclusive under the alternate type specification method for specific gravity, and the penetration at 25 degrees C. (77 degrees F.)

Alternate Type Specifications

	A		B		C		D		E	
Sp. Gr. ..	0.97	1.00	1.00	1.03	1.03	1.04	1.025	1.05	1.04	1.06
Pent.	75	90	90	100	70	90	85	95	140	160

In the case of a blanket specification to cover the same grades of the several types, the limits for specific gravity would have to be 0.97 to 1.06 and the limits for penetration would be 70 to 160. The penetration test, for example, can only be of maximum value when applied to the grade of a specific type of bituminous cement which is most suitable for the type of pavement in question. In the case of the bituminous concrete pavement of the type mentioned, the proper penetration limits for a California asphalt lie between 70 and 90 while for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions, the penetration limits should be between 140 and 160. It is evident that to attempt to cover the penetration limits for both materials in one specification is impracticable. In the first place such limits as 70 to 160 are so wide as to insure but little uniformity in different lots of the same material and in the second place an entirely unsuitable material of one class could be supplied under the maximum or minimum test limits of the other class.

The proper use of alternate type specifications allows the contractor to bid to supply so many tons of bitumen which will comply with any one of the sets of requirements. It will be noted, therefore, that the contractor is in exactly the same position as in the case when he bids to supply any asphalt cement which will comply with the requirements of a blanket specification.

Guarantees

There has been a general tendency to abandon the use of guarantees on bituminous pavements as it is believed that, with proper specifications and efficient supervision and inspection, guarantees are not necessary and that the requirement of a guarantee materially increases the prices bid on a given pavement. The subject of guarantees is too broad to discuss in this paper.

Bituminous Macadam Pavements

In addition to the improvements noted above, the most notable recent development in the construction of bituminous macadam pavements has been in connection with the compaction of the road metal and the distribution of the bituminous materials.

As a result of the numerous failures of bituminous macadam pavements which have occurred due to the improper rolling of wearing courses of road metal prior to the application of bituminous material, there has been a general recognition of the necessity for more thorough compaction of the road metal. This principle has been recognized by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers in its 1915 Report, the conclusion referred to reading as follows:

"An important factor for successful results is the proper compaction by rolling of the road metal before the spreading of the bituminous material."

The above Committee emphasizes another improvement which is aimed at the use, in some cases, of an excess amount of bituminous cement in this type of pavement. This conclusion is as follows:

"Present indications are to the effect that the use of bituminous materials in quantities of more than 2½ gallons per square yard where the upper course of the macadam is to be 3 inches in thickness after compaction is inadvisable under the penetration method."

There has been a general recognition of the advisability of using properly designed distributors in connection with the application of bituminous materials in order to secure uniform distribution economically. Some specifications cover the requirements which a distributor must meet. For example, the 1914 Specifications of the American Society of Municipal Improvements contain the following paragraph pertaining to the pressure distributor.

"The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than twenty (20) pounds nor more than seventy-five (75) pounds per square inch in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the Engineer while walking beside the distributor. It shall be so operated that, at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributor shall be provided with wheels having tires each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For a two (2) foot diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter."

This specification provides for a distributor by which it is practicable, under competent supervision, to secure uniform application of the bituminous material and allows the use of a pressure distributor without danger of rutting of the wearing course of broken stone by narrow tires carrying excessive weights.

Bituminous Concrete Pavements

The improvements in the construction of bituminous concrete pavements to which attention should be called will be considered under the following classification of the three types into which bituminous concrete pavements generally may be divided. These types are designated as follows:

(a) A bituminous concrete pavement having a mineral aggregate composed of one product of a crushing and screening plant.

(b) A bituminous concrete pavement having a mineral aggregate composed of a certain number of parts by weight of volume of one product of a crushing and screening plant and a certain number of parts by weight or volume of fine mineral matter such as sand or stone screenings.

(c) A bituminous concrete pavement having a predetermined mechanically graded aggregate of broken stone or gravel, either alone or combined with fine mineral matter, such as sand or broken stone screenings.

Patents

Unfortunately the present status of patent litigation has to be considered in connection with the discussion of the several types of bituminous concrete pavements. The majority of engineers and highway officials are interested in the types of bituminous concrete pavements which may be constructed without danger of litigation rather than in a prolonged discussion of the probabilities of successfully defending suits for infringement. There is ample evidence at hand that bituminous concrete pavements of type (a) may be constructed without danger of litigation proceedings provided that the mineral aggregate is of the general character heretofore mentioned in this paper under the section "General, Non-Bituminous Highway Materials."

The history of litigation cases indicates that the construction of bituminous concrete pavements of type (b) on a large scale will in all probability lead to litigation. The same remarks apply to the construction of bituminous concrete pavements of type (c) except in the case of the so-called Topeka bituminous concrete pavement with an aggregate of the type specified either in the 1910 Topeka decree, or of the grading which was adopted at the 1915 Convention of the American Society of Municipal Improvements.

Materials

Type (a). Practice has demonstrated that broken stone, because of the satisfactory mechanical bond secured, makes the most suitable aggregate for this class of bituminous concrete although pavements constructed with gravel have proved satisfactory for light traffic where great care has been taken in the selection of the gravel and in the construction of the pavement. The development of the character of materials used in current practice has been covered in this paper under the title "General." Much more care has been taken in recent years with reference to the quantity of bituminous cement to be used in the mix. There has been a general recognition that the amount used depends upon the kind of road metal and the bituminous material, the character of the aggregate and the climatic conditions. For the product of broken stone heretofore mentioned, it has been found that bituminous concrete mixtures should contain between 5 and 8 per cent. by weight of bitumen.

Mixing

Many improvements are noted in the methods employed in the mixing of bituminous concretes. There has been a general evolution from hand mixing methods to the utilization of mechanical mixers especially designed for the manufacture of this type of bituminous concrete.

There has been considerable discussion pertaining to the proper type and weight of roller to be used for the compaction of the wearing course. Experience demonstrates that in order to secure an even surface and adequate compaction by thorough interlocking of the particles of broken stone, a tandem roller weighing between 10 and 12 tons should be used.

Seal Coat

Many methods have been developed for the application of the seal coat of bituminous material. It has been found that seal coats of from ½ to 1 gallon per square yard of bituminous cement are distributed most uniformly by the use of hand-drawn gravity distributors followed by a squeegee.

Experience in many localities has demonstrated that bituminous concrete of this type should not be mixed or laid when the air temperature in the shade is below 50 degrees F. as otherwise it is difficult, under average conditions, to secure an even and well compacted wearing course.

Type (b). Specifications for this type of pavement have, during recent years, generally stipulated that so many parts of broken stone and so many parts of sand or other fine material are to be mixed with a certain amount of bituminous cement. By the use of this specification, unless employed under unusual supervision, it has been found to be impracticable to secure a well graded aggregate. In many cases the mixture has contained an excess of broken stone with insufficient fine material to fill the voids therein, while in other cases it has contained an excess of sand in which the broken stone exists as isolated particles. It is the conclusion of many engineers, because of the conditions described, that when bituminous concrete pavements are to be employed either type (a) or type (c) should be selected.

Type (c). During recent years, the bituminous concrete pavements of this type which have been most extensively employed are known as Bitulithic, Warrenite, and Topeka.

Bitulithic and Warrenite. Differentiation.

The general use of Bitulithic and Warrenite bituminous concrete pavements throughout America has brought up for discussion the matter of the fundamental differences between these two types of patented pavements. It is believed that it will be of interest and value to the engineering profession to submit the following statement, prepared by Mr. George C. Warren, President of the Warren Brothers Company, for the information of the engineers enrolled in the Graduate Course in Highway Engineering at Columbia University.

"Bitulithic and Warrenite mixtures are both made under the provisions of the Warren patents, which the courts have held 'cover the product no matter how produced.' Bitulithic is designed to meet the conditions generally prevailing on city streets, and Warrenite is to meet such conditions as may arise on country roads so as to meet the physical and economic conditions and public demands as to cost.

"Generally speaking, Bitulithic is mixed by a plant which is too cumbersome to meet country road conditions, which provides for combining the materials proportioned by separation of sizes of the aggregate, after heating, and then recombining by weight.

"Warrenite is, generally speaking, mixed by a plant so portable that it may be set up either alongside the railroad; along the side of the road being constructed, or in the quarry or gravel bank from which the bulk of the aggregate is being procured as may be most economical in any particular case. This plant is constructed on the principle of proportioning the several separated sizes by careful measurement by bulk before heating and retaining the batch so measured as a separate entity through the process of heating and delivery into the mixer in which the bituminous cement is added.

"Generally speaking, crushed stone predominates in the fine aggregate of Bitulithic, while sand predominates in the fine aggregate of Warrenite; also, fine crushed stone and sand respectively are correspondingly used for the seal coat aggregate.

"In the selection of quality of material (whether gravel or crushed stone) for the coarse aggregate a greater latitude is permitted in the case of Warrenite to practically meet the conditions of less opportunity for selections which are liable to prevail in localities considerable distance from railroad centres. This latitude is allowed, because while the traffic conditions on country road thoroughfares are in point of weight and concentration of traffic rapidly becoming fully as severe as on most city streets, there is the important difference that on country roads generally the traffic is more exclusively the motor vehicle rubber tire type and consequently less exaction in physical properties of the quality of the stone forming the basis of the aggregate is necessary. Also, unfortunately, many city streets are abused by constant excessive sprinkling or daily scoured by pressure flushing machines, a practice which is more or less injurious to any road surface, while country roads are seldom, if ever, wet except by rainfall; therefore, in cases where the very best quality of stone is unavailable, it would be safe to use stone of slightly lower quality in Warrenite on a country road although the same quality stone might not be safe for use in Bitulithic on a city street."

Topeka

In many specifications the mineral aggregate for the Topeka pavement specified has been that contained in the decree of 1910, namely,

"Bitumen, from 7 per cent. to 11 per cent.

Mineral aggregate, passing 200-mesh screen, from 5 per cent to 11 per cent.

Mineral aggregate, passing 40-mesh screen, from 18 per cent to 30 per cent.

Mineral aggregate, passing 10-mesh screen, from 25 per cent to 55 per cent.

Mineral aggregate, passing 4-mesh screen, from 8 per cent to 22 per cent.

Mineral aggregate, passing 2-mesh screen, less than 10 per cent.

Many unsatisfactory pavements have resulted by the unintelligent use of this grading. It has been found necessary, in order to secure successful results, to specifically define the character of the sand or other fine material which shall be employed in order to secure a satisfactory grading. Many specifications now cover the sand grading with almost the same care as in the case of sand grading requirements for sheet asphalt pavements. In order to encourage the use of a more satisfactory grading for this type of pavement, the American Society of Municipal Improvements in 1915 recommended the adoption of the following grading:

Passing 200-mesh screen	7-10 per cent.
Passing 80-mesh screen, but retained on a 200,	10-20 per cent.
Passing 40-mesh screen, but retained on an 80,	10-25 per cent.
Passing 20-mesh screen, but retained on a 40,	10-25 per cent.
Passing 8-mesh screen, but retained on a 20,	10-20 per cent.
Passing 4-mesh screen, but retained on an 8,	15-20 per cent.
Passing 2-mesh screen, but retained on a 4,	5-10 per cent.

Fourth Annual Report of the Public Utilities Commission of Manitoba

The fourth annual report of the Manitoba Public Utilities Commission for the year ending November 30, 1915, has just been published. The report terminates the period of office of the present commissioner, Mr. H. A. Robson.

The appointment of Mr. George Guy as electrical engineer of the Commission is announced, which, it is expected, will greatly facilitate the work of the Commission, as Mr. Guy's professional ability and practical experience will be invaluable in settling the many technical matters which are constantly arising. The Commission have removed their offices from Somerset Building to more capacious accommodation in 201 Tribune Building.

Professor Albert F. Ganz, appointed by the Commission to discover and apply a remedy to prevent injury to water pipes by stray electric currents from electrical railway return circuits, presented his report, and upon it the Commission, issued an order against the Winnipeg Electric Railway Company to install and establish a proper system of bonding and cross-bonding of the rails in order to provide a continuous conductor and prevent stray currents. The Winnipeg Electric Railway Company have resisted this order, and have entered an appeal in the Court of Appeals for Manitoba against it.

The enlargement of the Commission by the appointment of an electrical engineer will open a field of assistance to municipalities about to enter into public utility undertakings. The Commission will thus be enabled to investigate and advise on municipal contracts in the public interest, and thereby assist in securing proper construction and operation methods such as will ensure efficient service. Municipalities and public utility companies will be free to ask the Commission for advice as to the feasibility of any proposed public service, and the Commission may investigate and recommend what service will be in the best interests of the municipality. This will undoubtedly prove a valuable aid to municipal and privately owned utilities throughout the province and be the means of bringing all concerned into closer relationship.

Utilizing Domestic Coal

In the report presented at the last session of the Legislature on the possible hydro-electric development in the province, reference was made to lignite coal and its possible adaptability for power purposes. The government gave practical demonstration of its interest in the investigations and experiments made by the Commission through its gas engineer, Hugh McNair, upon the uses of native coals for power production throughout the province. The installation of a model gas producer plant, which the government has authorized to be purchased in England, will demonstrate the possibilities of using the lignite coals of this province and Saskatchewan economically for power and heating purposes. If the experiment should prove the practicability of this, a great step forward will have been accomplished in supplying a readily adaptable form of power, and at the same time converting into an asset part of the large bodies of lignite coal and peat lying dormant here. The plant will be installed at Souris, where experiments already have been conducted by the Commission's gas engineer.

Telephone Report

The financial statement of the Telephone Commission of Manitoba for the year ending November 30, 1915, appears in this report. The service given to subscribers has on the whole been satisfactory.

Depreciation Account

The Public Utilities Act of Manitoba provides that the Commission shall have power after hearing upon notice, to require every public utility to carry, whenever in the judgment of the Commissioner it may be reasonably required, a proper and adequate depreciation account for the protection of stock holders, bond holders or creditors. Soon after the Act came into effect the depreciation reserve fund of the Manitoba Government telephone system was established, according to the rates of depreciation fixed. As the fund is made up of percentages of assets which may not wear out or require replacement, it accumulates. As there appeared no likelihood for its immediate need, it was considered advisable to invest a portion in bonds of the province.

The general report states briefly the number and nature of enquiries and investigations held by the Commission during the year, and recounts briefly all the matters of varied character which came before the Commission's attention.

Program for Montreal's Annual Municipal Clean-up Campaign

Montreal has had a clean up campaign since 1912, when the Mayor made an official proclamation of a clean up day at the instigation of the City Improvement League backed up by a petition signed by 132 public bodies and institutions. In that year and the following year operations were confined to one day, but the movement was so successful that in 1914 and 1915 the period was extended to a week, and this year—May 14-20—the same time is allotted to the efforts to put the city in a cleaner state. Owing to climatic conditions, Montreal is in a much more unfavorable position than many United States cities; the lanes are choked with ice and snow during several months, and although the garbage is removed regularly, a certain amount of decaying matter and ashes is bound to accumulate and is covered by successive layers of snow, making it imperative to have a clean up week in the spring.

While in the United States the initiative is taken by the insurance companies, in Monteal it is in the hands of the City Improvement League and the Montreal Publicity association, assisted by the civic departments. The funds for the propaganda and other expenses are raised by contributions, with a civic grant. The work done is practically all voluntary, and is carried out by a number of committees, to which are relegated various sections of the activities of the campaign. The chairmen of these committees are responsible for the carrying out of the particular work, entailing a large amount of personal attention and organizing effort. Owing to the mixed character of the population, all literature has to be printed in French and English, and in this connection it may be noted that the two nationalities co-operate in a very cordial way.

In 1912 in addition to a clean up day, a great Child Welfare or Health Exhibition was held for two weeks, to which the public were admitted free of charge, while two years later the general movement received a decided impetus from the fact that the Montreal Publicity Association joined hands with the League, a week's campaign being then decided on, at the suggestion of Mr. F. Abraham, president of the former body. The city provided a certain amount of money, and the heads of the incinerator, fire and health departments joined the general committee. The clergy of all sects and races have undertaken the first day of the week as "Sermon Day." This year the School Commissioners of the city have promised their special co-operation, through the medium of the teachers and the schools.

The nature of the campaign can be judged from the following programme:

Sermon Day

Sunday, May 14th—Hear the sound advice from the pulpits to keep physically and morally clean.

Fire Prevention Day

Monday, May 15th—Bear in mind that carelessness is the chief cause of fires—and that each fire prevented means thousands of dollars saved to the community.

Front Yard Day

Tuesday, May 16th—Make the surroundings of your home congenial—sow grass on the lawns, plant flowers—take good care of the trees.

Back Yard Day

Wednesday, May 17th—Clean your backyard of all rubbish—make it a small vegetable garden. Keep the fences in order. Whitewash them with lime.

Sanitation Day

Thursday, May 18th—Remove all rubbish, clean all carpets, ventilate your cellars. Scrub everything. Use plenty of soap and water everywhere.

Paint Up Day

Friday, May 19th—Make everything radiant with fresh colors. Follow the example set by nature. Be bright. Keep bright.

Children's Day

Saturday, May 20th—50 per cent. of the newly born babies die before they are one year of age. Do something to stop these needless deaths. It is worse than murder to keep infants unclean—and to give them food that is worse than poison. The clean-up campaign two years ago saved the lives of 200 infants. Last year it saved 382 lives more than the preceding year. It may save yours this year.

The feature of the 1915 campaign was the enlisting of children's interest in the work—due to the suggestion of Dr. W. H. Atherton, who had been the organizing secretary of the Child Welfare Exhibition in 1912. It was felt that no better way of securing sanitary conditions could be devised than to obtain the co-operation of the boys and girls. This year, greater emphasis and concentration is being laid on this department and with the co-operation of the schools the programme is arranged with this end in view. In order to encourage the children, $1,250 are being given in prizes. The city is divided into five districts, $250 being allotted to each. The children are reached mainly through the various schools. The teachers ask the pupils who desire to enter the competition to sign a form, which provides for two competitions, one from May 7 to June 7, and the second from then to end in September. The second competition is an optional supplementary one, with other prizes, obtained through the Merchants' Committee, for those who will keep up the good work until the end of the summer. The points to be considered by the District Organization Committee in judging are as follows:

Relative to Backyard—The absence of all rubbish, such as cans, ashes, broken glass, straw, chips, etc. Also freedom from weeds.

Relative to Front yard—Absence of all rubbish, cans, straw, etc. Freedom from weeds. Front yard in grass, and if kept trimmed.

Relative to Exterior Improvement.—The painting of the exterior of the house, such as verandahs, balconies, etc. Or if these do not need painting this year, the cleaning of them. The cleaning out of sheds. The painting or whitewashing of sheds. The strengthening of fences, and the painting or whitewashing of same. Or the screening of them with vines or flowers.

Relative to. Flower and Vegetable Planting—The making of flower gardens, in the front yard, and the putting of flower boxes in the windows. The making of vegetable and flower gardens in the back yard. Several beds of vegetables, such as radishes, beets, carrots, etc., can be made in the centre of the yard, with some flowers around the sides, along the fences. The care given to flowers and vegetables after planting.

Relative to General Improvement—Consideration given to state of premises before work of cleaning-up, and planting begins.

Relative to General Appearance of Premises.—The judges to give consideration as to how all parts of the premises have been given attention. The contestant to win must have a well balanced piece of work.

The scoring to count as follows: general appearance of back and front yards relative to cleanliness to score up to 30 per cent.; general exterior appearance to score up to 20 per cent.; flower and vegetable planting to score up to 25 per cent.; general improvements to score up to 15 per cent.; general appearance to score up to 10 per cent.

Another feature this year is to be moving pictures at several halls in the different districts. This is an extension of work previously done in the same direction. In other years at the spring cleaning lantern slides of an educational and hygienic character were shown, though in 1914 moving pictures were exhibited in the parks later in the summer. In order to vary the interest, moving pictures of a general character will be shown together with those of educational value, and in this manner the minds of the children will be impressed in a way which is calculated to have a permanent effect. The children are also, at the various meetings, asked to sign the following pledge:

"I want to help make our town a better place to live in, and to this end I promise to comply with the following rules to the best of my ability:

1. I will help clean up yards, streets and alleys.

2. I will plant flower seeds, bulbs, vines, shrubbery, etc.

3. I will help make gardens, and keep lawn in good condition.

4. I promise not to deface fences or buildings, neither will I scatter paper or rubbish in public places.

5. I will not spit upon the floor of any building or on the sidewalk.

6. I will try to influence others to help keep our town clean.

7. I will always protect birds and animals, and all property belonging to others.

8. I promise to be a true, loyal citizen.

I may not be able to do all these things, but will do as much as I can to help our town and community.

Name ....

Address ....

Sign and Mail this to P. O. Box 368, Montreal, or hand same to your school teacher.

Prior to clean up week circulars were sent to all the large industrial plants, stores, etc., asking that an individual clean up campaign be made of the premises. This had been acted upon with willing co-operation, and the employees are thus set an example which will likely be followed around their own homes.

The City Improvement Campaign Committee takes every means to impress on the public the importance of following out the programme. Through the daily press and the Publicity Committee attention is drawn to the various items, while the committee in charge of the particular day also makes inspections. In addition thousands of booklets are distributed; these insist upon the absolute need of sanitation, as the means of preventing disease and death. The clean up week has also become a Public Health week. In this year's pamphlet, Dr. Boucher, the chief of the health department, suggests rules for saving children, and enumerates five "Don'ts" as to methods of sanitation. Fire Chief Tremblay also tells how to prevent fire.

The work of the City Improvement League is by no means confined to the clean up campaign, as it is interested in town planning, the care of public parks and trees, the extension of vacant lot gardens, and good government generally.

Preservation of Woodwork

Generally speaking, any wood will last a long time when protected from moisture. It would, however, lose its agreeable color and surface unless some means are used to protect it. The use of chemical preservations is confined almost entirely to underground timbers and so has little use in millwork. One of the places millwork would be benefitted by chemical treatment is at the base of porch columns, where treated wood might well be used where water is apt to penetrate. Creosote is the best of practically all preservatives, and there are a number of methods of using it. Paint is also effective if water can be kept out of all cracks, crevices, joints, etc. Where the paint merely holds the water in a pocket, we have the ideal conditions for fungus growth and ultimate decay.

A Few Suggestions for the Solution of the Single-House Sewage Disposal Problem

The growing popularity of modern conveniences in the shape of water and sewage conveniences in isolated and rural residences or in small communities, has resulted in the establishment of a more or less standard arrangement very much improved as compared with the practices of a few years ago. For the solution of the single-house sewage disposal plant there may be used the plain sedimentation tanks, such as leaching cess-pools and sewage cisterns; septic tanks of different forms and the double deck or Emscher tanks. The first type is rarely used being as a rule not very satisfactory; leaching cess-pools are a serious menace to wells in the vicinity due to possible soakage through the soil and contamination of the water; little or no reliance can be placed on the surface slope of the ground with respect to placing a cess-pool relatively to the well; the under strata may slope directly opposite to the surface and form a very effective drain from the cess-pool into the well. Sewage cisterns are usually unsatisfactory because they involve the periodical removal of sludge, a troublesome problem.

Septic tanks have increased in favor with the public and sanitary engineers since their introduction as a means of sewage treatment and are very widely used though often incorrectly and more or less unintelligently. The two storey or Emscher tank is coming to be favored by sanitary engineers, because it produces a fresh, well settled, effluent, and provides for a very complete retention and thorough digestion of the sludge. This type is adapted for a small community rather than for single houses.

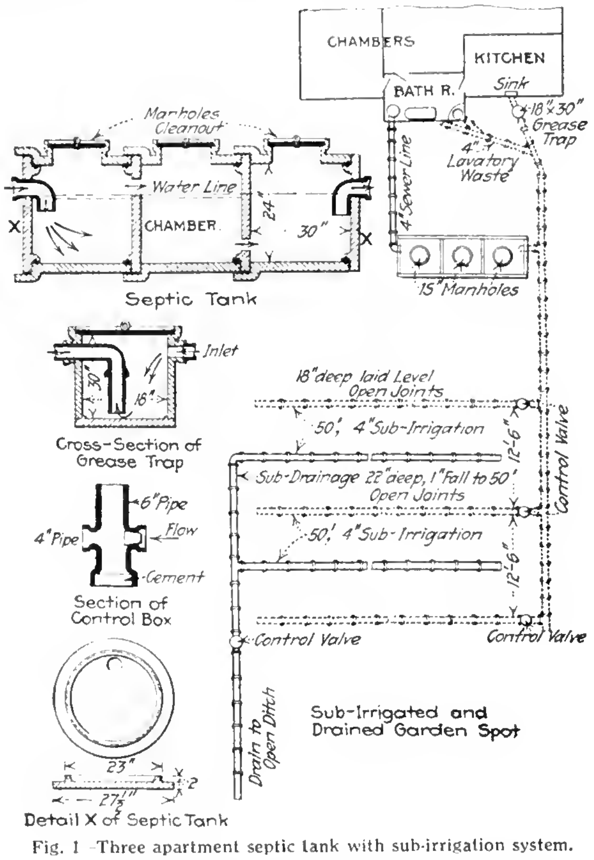


Fig. 1 -Three apartment septic tank with sub-irrigation system.

For a small community the only adequate solution of the sewage disposal problem is a well planned system of sewers covering the entire community. The entire system need not be built at once, but only as deemed necessary and as the community is able to finance it. The whole system should, however, be planned in advance before any mains are laid at all. Treatment of sewage by carrying it to a single outfall by intercepting sewers is, relatively to the size of the community, very expensive and not always satisfactory—depending largely on the grade and slope or the topography of the town site.

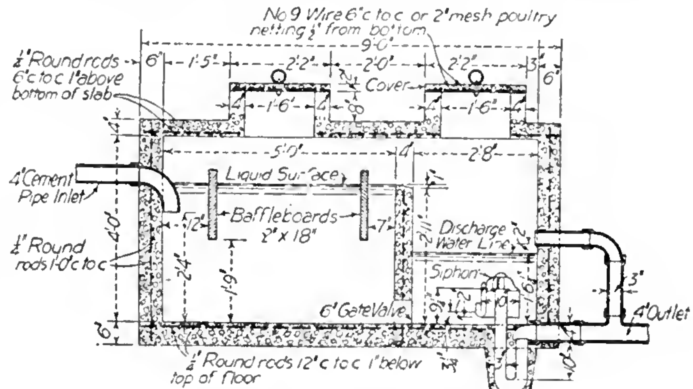


Fig. 2—Single apartment septic tank with siphon and siphon chamber

The system of sewers which, with very few exceptions, is best adapted to meeting the necessity of a small community for purifying the sewage is the so-called separate system, as distinguished from the combined system, and is more economical with a reasonably good natural drain.

In a community with a stream into which the sewers may empty, if the flow exceeds 5 cubic ft. per second for 1,000 persons, crude sewage may be discharged directly into it without nuisance, if the outfall is properly designed to insure a good mixture of sewage with the water in the stream. If the minimum stream flow is below 5 cubic ft. per second and over 3 cubic ft. per second for 1,000 persons using the sewers, then some form of fine screening or treatment in tanks to remove solids is necessary. As fine screening cannot be applied except on a rather large scale, the small community is practically confined to the use of tanks. If the dilution available is less than 3 cubic ft. per second for 1,000 population, some form of filtration must be added, such as sand filters, contact beds or sprinkling filters.

Leaching cess-pools and sewage cisterns are usually nothing more than some form of containing receptacles built to suit requirements. The septic tank in its simplest form is a single apartment bottomless tank or a tank set on timber, built in loose sandy soil in which the effluent will soak away. The bacteria which compose the mat on the surface of the sewage liquor and feed on the raw sewage, converting it into clear effluent, are anaerobic requiring no air to carry on the chemical decomposition of the raw sewage.

The next step in the development of the septic tank is that used in heavier soils which requires distributing tiles to dispose of the effluent. The layout of such a tank is shown in Fig. 1. It is a vitrified-clay septic tank with sub-irrigation tiles distributed beneath the owner's garden. The tank is in three sections or chambers of 2 ft. x 2½ ft. each, with an estimated daily capacity of 50 gallons.

The kitchen and bathroom waste need not pass through the septic tank, but may go directly to the sub-irrigation system. Only sewage containing solids or putrescible matter need pass through the tank.

A still further modification of this style of tank is one employing a syphon chamber and a syphon, as shown in Figs. 2 and 3. This tank shows only one section but it may be enlarged to any number to suit the capacity of the system. The use of the syphon regulates the discharge so that a relatively large

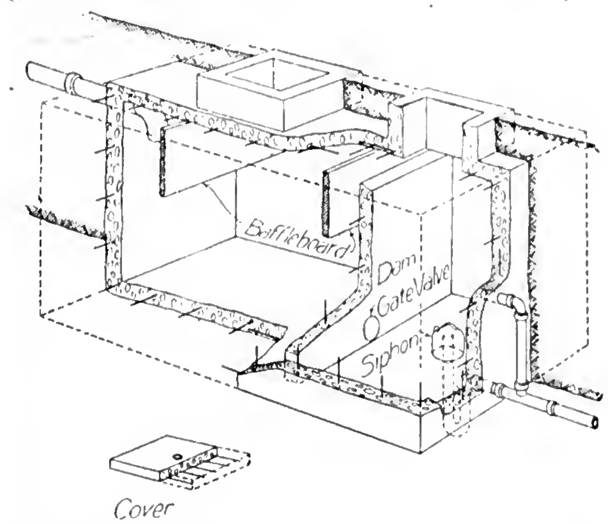


Fig. 3—Perspective of tank shown in Fig. 2, showing concrete construction.

amount of effluent is discharged into the tile, in a short space of time providing a pressure head which distributes the effluent to the extreme end of the tile lines. If no syphon is employed and the tile slope is comparatively small, the discharge is slow and the ground near the tank is likely to become over-saturated and sour.

Where a sewer outlet or a tile disposal system for the effluent is used, the tank should be built of reinforced concrete entirely, as shown in Fig. 3. For average capacity, a 4 in. inlet and outlet is sufficient, although it is better to have pipes too large rather

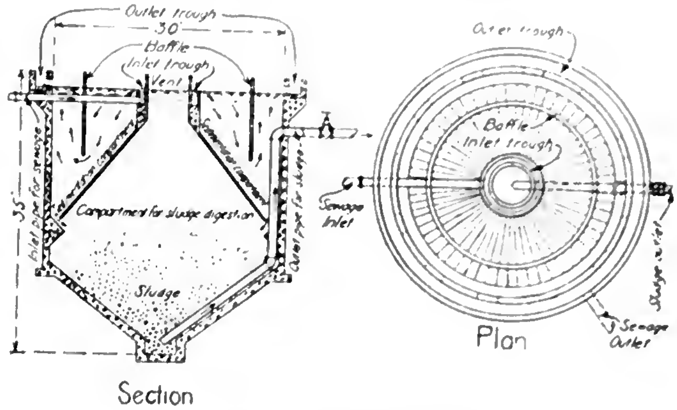


Fig. 4—Double Deck or Emscher Tank.

than too small. Place the tile in porous ground, if possible avoiding tight soil, at a distance of at least 24 in. underground. With pipes at this depth very little trouble from frost will be experienced; keep the top of the tank at least 8 in. to 10 in. below ground level to avoid danger from frost. This depth need not be excessive, as a certain amount of heat is generated by the chemical action of the decomposition of the sewage.

Fig. 4 shows an Emscher sewage tank. Sewage is introduced in the centre and passes under a battle plate which causes the sediment to pass down through the sediment department into a sludge digestion chamber, from which, when thoroughly digested, it is pumped off. Sanitary engineers claim for this tank very good results, producing a well settled effluent and a thoroughly digested sludge.

New Station for the L. E. & N. at Brantford, Ont.

In connection with the Lake Erie and Northern electric railway, now in course of construction from Galt to Port Dover, it is proposed to erect a large station at Brantford. The new line, which will connect with the C. P. R. main line at Galt, is open from the latter town to Brantford, and it is hoped to have the entire line to Port Dover completed by June. In addition to the usual passenger service, arrangements are being made to carry considerable quantities of freight.

The station at Brantford is to be one storey in height, and will be located over the tracks at the south west corner of Colburn and Water streets, with a 38 ft. frontage on Colburn street and 70 ft. on Water street. The tracks will pass beneath the main floor of the building, with platforms, express and baggage accommodation at the lower level. New England, Colonial style, red brick and limestone trimmings are to be used for the exterior, the roof being of green slate. The main floor at the street level, with an entrance from Colburn street, will contain a waiting room 35 feet x 50 feet, a women's retiring room, and lavatory, men's lavatory, and ticket and telegraph offices. The seats extend the full length of the two outside walls in the waiting room, except in the space occupied by the ticket and telegraph office. Two

New L. E. & N. Station at Brantford, Ont.

stairways will lead from the main floor to the track platform. Provision is made for the express room and the steam heating apparatus in a separate extension 14 ft. wide x 75 ft. long, on the lower or track level. This extension abuts on the retaining wall of Water street and will be accessible for teams at the lower end of the street. The interior of the building will be finished in Canadian Ash, while the walls and ceilings of the main waiting room are to be plastered and finished with plastered cornices. The floors are of concrete. The toilet rooms will have marble wainscots 6 ft. x 9 in. high. The estimated cost is $25,000.

The Canadian Northern Pacific Railway Terminals at Victoria, B. C.

When General Manager MacLeod, of the Canadian Northern Pacific Railway, visited Vancouver on March 28th he carried with him the plans of the company's $1,000,000 terminal passenger depot and of its freight terminals to be erected on the reclaimed lands in False Creek, Vancouver. Mr. MacLeod was accompanied by Mr. R. B. Pratt, architect of the company, under whose supervision the plans were drawn. At a conference with the bridges and railways committees of the city council—which body has been anxiously awaiting a start on construction—Mr. MacLeod stated that as soon as the plans were approved by City Engineer Fellowes he was ready to call for tenders for the foundation and main structure, and would promise that no time would be lost in its erection. After hearing the representatives of the company explain some of the details, the plans were referred to the city engineer to ascertain if the structure as shown on paper would conform with the company's agreement with the city as to cost, namely, $1,000,000.

The drawings presented show a structure of classical Doric design, 321 feet long by 120 feet wide, of modern fireproof construction. Twelve huge Corinthian columns stand at intervals across the entire front. The centre portion of the proposed structure reaches to a height of 100 feet from the ground, the tower proper being 96 feet high. The ends of the building stand 64 feet high, and those portions between the centre and the ends, 60 feet high. These sections are three storeys in height, while the ends and the centre portion are four storeys high. The building is designed for white or grey stone.

Many modern features are embodied in the interior design. A large main entrance is provided in the central portion through which a passage runs into a very wide lobby leading into the general waiting room, 150 feet long and 50 feet wide. In this room are the ticket offices, etc. Adjacent to the ticket offices is the baggage room and on the opposite side of the building, with means of access from the waiting rooms, are the lunch and dining rooms. There are numerous lobbies off the waiting room. A barber shop is provided; a men's waiting room and a women's waiting room and retiring room; a government mail room and the dining and sleeping car department; C. N. Express company and commercial telegraphs. The upper storeys are devoted to traffic offices, and the basement is to be utilized for storage purposes, etc.

A great passage-way leads from the waiting room to the train tracks at the back of the station. Here a large covered concourse is provided, 50 feet wide and covered platforms from 1,200 to 1,500 feet long. Provision is made for sixteen tracks.

The floors throughout are of terrazzi and marble; the stairways are marble and the finish throughout is in natural wood. It will take from nine months to one year to erect and complete the depot.

B. C. Material to be Used

Mr. MacLeod stated that it was his company's intention to purchase as much of the material required in British Columbia, as is possible, and Mr. MacLeod was told the city would want stone instead of terra cotta wherever the latter was called for.

The ground plans show the location of the depot sixty feet south of the proposed Great Northern station. A main roadway, 125 feet wide, running east from Main street, divides the company's property in

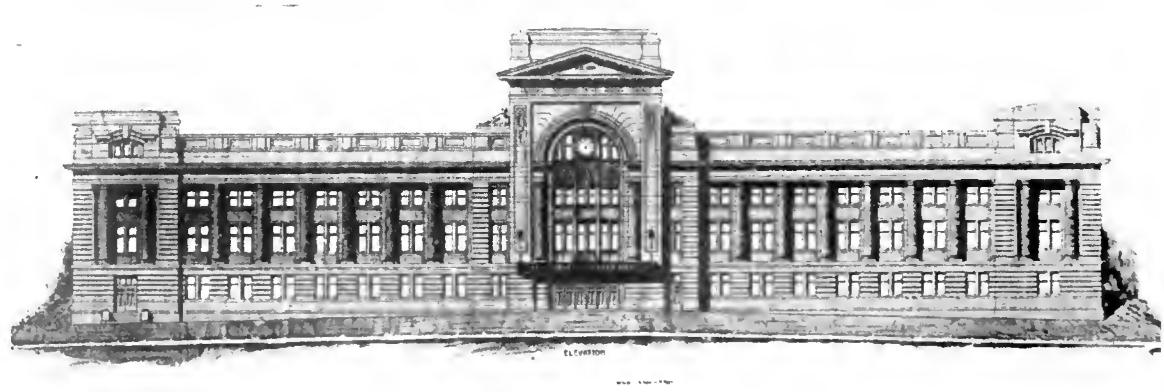


Fig 1—Architect's perspective of the C. N. P. Terminal, Victoria, B. C.

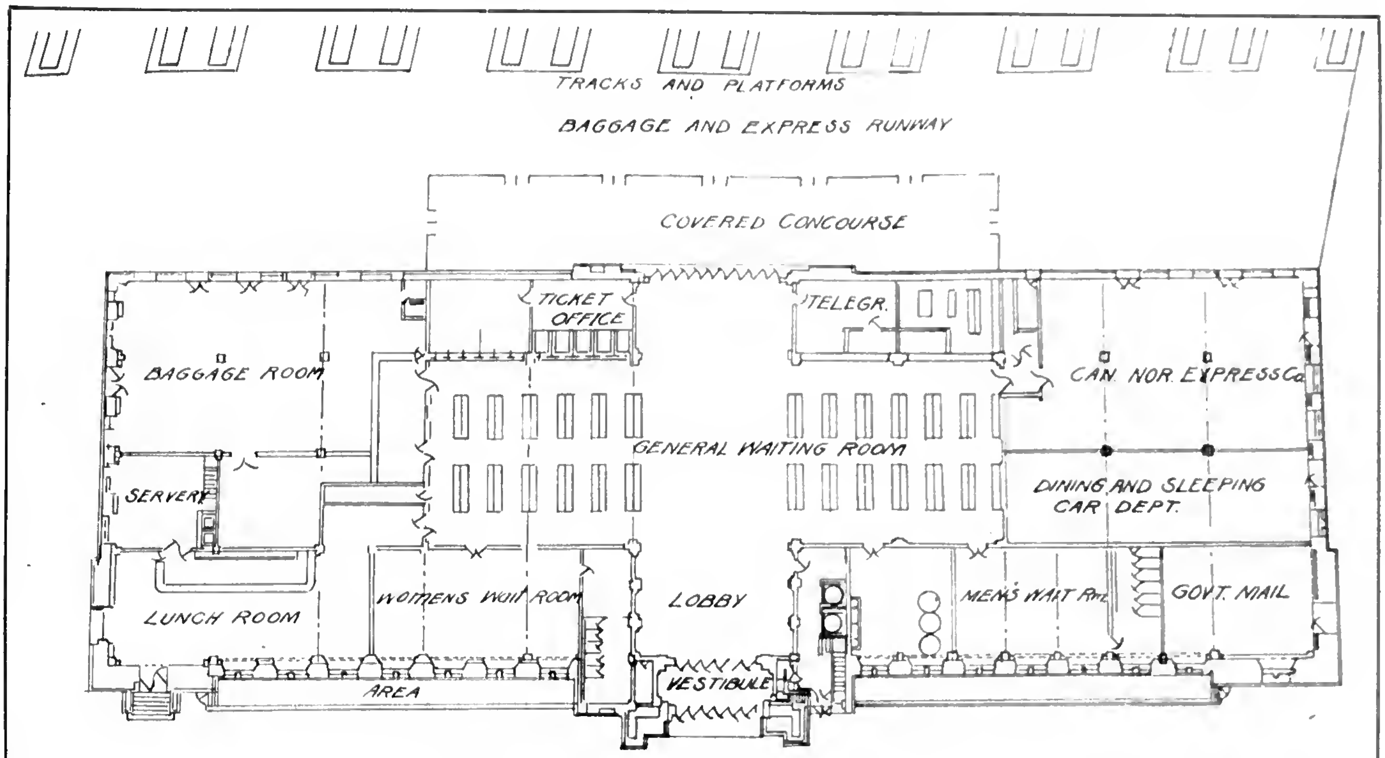


Fig. 2—General Layout of the C.N.P. Terminals at Victoria, B. C.

two, on either side of which provision is made for industrial sites on the north and freight sheds on the south. According to the agreement with the city, 12 acres at the northeastern end of False Creek are left. This belongs to the city. A roadway, 125 feet wide, is shown in front of the depot, running from north to south.

American Lead Pencil Co., New York

A unique and useful sample box is being sent on request to technical and professional men by the American Lead Pencil Co. of New York, who have had made up at considerable expense a box about three inches square, which contains nine degrees of Venus pencils, ranging from hardest to softest, also a pencil holder and a small size of the new Venus eraser. This little test kit enables the recipient to determine exactly which degree of hardness or softness best suits his purpose, so that in the future he can order a certain degree and know that it is exactly what he requires.

London Concrete Machine Company, Limited

The London Concrete Machinery Company, Limited, advise us that they have been awarded the following contracts:—Mr. Camillus Van Caeseele, Langenburg, Sask., to be supplied with 1/6 yard batch mixer; Shawinigan Water and Power Company, Shawinigan Falls, Que., with a 1/3 yard batch mixer; Mr. Ernest Jones, Granton, Ont., with a ¼ yard batch mixer; Mr. W. H. Casselman, Chesterville, Ont., with a 1/6 yard batch mixer.

The B. F. Sturtevant Company, Boston, Mass., are distributing general catalogue No. 195, which describes, with illustrations, the various Sturtevant products.

Mr. Lucius E. Allen, Consulting and Constructing Engineer, Belleville, Ont., announces the removal of his offices to the New Bank of Commerce Building.

Miscellaneous

Mr. J. H. Kilmer has been appointed city engineer and inspector of water-works construction at Port Moody, B. C.

Active preparations for the "Good Roads Day" in Pennsylvania counties, which has been set for May 25, are being prosecuted by the counties of the state.

The Dominion Stove and Foundry Company, of Penetanguishene, Ont., are enlarging their plant in preparation for installing machinery for the manufacture of furnaces.

The new Wychwood branch library, Toronto, the gift of the Andrew Carnegie Library Trust, was formally opened on April 15, in the presence of a large number of residents of the neighborhood.

The demand for building and repair permits in Quebec during the week ending March 11 was quite brisk, there being issued eleven permits, representing an amount in new buildings and repairs of $14,590.

Because the owners would not consent to an early closing agreement, the plumbers and gasfitters of Hamilton, Ont., have been called out of the shops of Drake-Avery Company, Adam Clark, W. J. Walsh, and A. Rogers & Company.

The death is reported of Ex-Ald. John Martin, a former building contractor of Hamilton, Ont., at the age of 73. Eighteen years ago Mr. Martin left Hamilton to settle on a fruit farm at Vinemount, where he resided till the time of his death.

There continues to be a good deal of discussion in Ottawa relative to the proposal to increase the maximum height of buildings from 110 to 130 feet. Mr. Frank Darling, of Toronto, the architect for the Federal Town Planning Commission, who has been asked by the Board of Control for his opinion on this subject, is strongly in favor of the present limit of 110 feet being unaltered. He argues that as Montreal, a purely commercial city, finds that 130 feet answers all requirements, the capital of the Dominion should be willing to concede something in order that the Government buildings may largely dominate the city. The Board will take no further action in the matter until they get an idea of the Government's view.

City of Kamloops Hydro-Electric Plant

Detailed Description of Engineering and Economic Features of Power Generating and Pumping Systems of this Growing Western Centre

By H. K. Dutcher, M. Can. Soc. C. E.

It is the purpose of this paper to refer to some of the engineering and economic features in connection with the design and construction of the Municipal power plant and pumping systems of the city of Kamloops, which have been recently completed and placed in service.

These systems include a steam turbine power plant and pumping system, a new reservoir and a hydro-electric power plant and sub-station.

The steam power plant and pumping system, together with the sub-station of the hydro-electric plant are included in the one building, and located near the eastern limits of the city, while the generating station of the hydro-electric plant is located on the Barriere River, which flows into the North Thompson, the distance of this plant from Kamloops being about forty miles almost due north.

During the course of examination of the several streams available for power within practical range of the city, there appeared to be some prospect that a company holding the power rights on the Adams River might develop power from this source, in which case the lands along the South Thompson River would be looked after.

Attention was directed, therefore, mainly to an examination of the streams flowing into the North Thompson River, and of these the Barriere River appeared to answer the requirements for power development most satisfactorily, especially in view of the two large lakes available for storage, the heavy grade of the stream and the convenience of the transmission line passing down the valley of the North Thompson through comparatively open country with a prospect of a power market along the entire route.

After some study of these different factors affecting the immediate and future requirements, the city finally decided to proceed upon the following scheme of construction:—

(a) The development of a hydro-electric power plant on the Barriere River with a capacity of at least 5,000 h.p., of which the first installation would provide for 2,000 h.p.

(b) The construction of a new steam plant and pumping station in the city, the steam plant to provide for either oil or coal fuel, and to have the first installation up to 2,000 h.p. capacity. The pumping plant to include two motor-driven centrifugal pumps to deliver 1,200 Imperial gallons per minute each, and one steam turbine pump of equal capacity.

(c) The construction of a covered concrete reservoir of 1,500,000 gallon capacity but designed for an extension to 3,000,000 gallons by the construction of a second section.

Barriere Hydro-Electric Power System

Barriere River

The Barriere River rises in the mountains near Adams Lake, flows in a westerly direction for a course of about thirty-two miles and empties into the North Thompson River at a point about forty miles north of Kamloops.

The total drainage area of the Barriere River is about 230 square miles, with an average precipitation of probably about 35 inches. The mean flow during a normal year would be about 550 cubic feet per second with extremes of about 3,600 cubic feet per second as a maximum in the early summer period, and 220 cubic feet per second in the low water season of the winter months.

Of the total flow about 80 per cent. comes from the

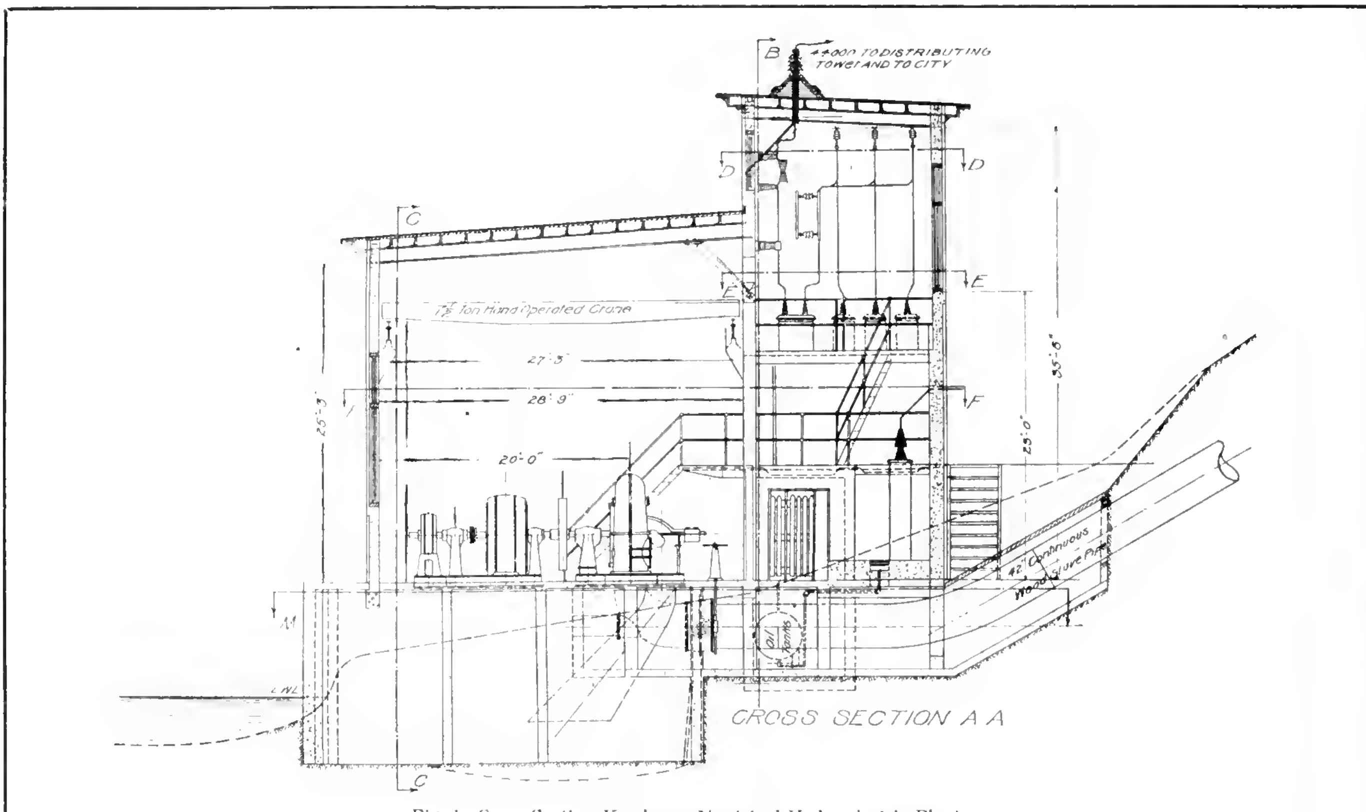


Fig. 1—Cross Section Kamloops Municipal Hydro-electric Plant.

North Barriere Lake, and with the provision of storage for 30,000 acre feet in the East Lake, there should be no difficulty in maintaining a flow of from 300 to 350 cubic feet per second for power development.

Power Development

As the elevation of the North Lake is about 2,100 feet above sea level and the elevation at the outlet of the river is about 1,500 feet, there is therefore an average grade of about 50 feet per mile. The plan of power development provided

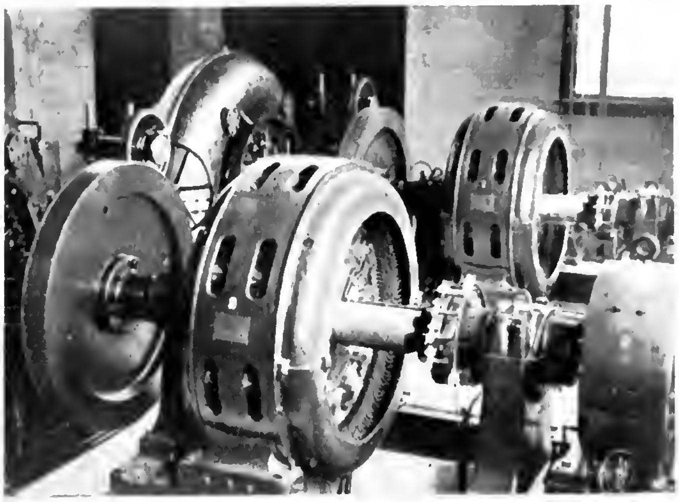


Fig. 2—Interior Kamloops Hydro Generating Station.

for the location of a generating plant at a point about five miles up from the mouth of the river.

For a distance of about 3½ miles above the site of the generating station the grade of the river averages 65 feet per mile, and a suitable site for an intake dam was located to give an effective head of 192 feet at the generating station by 17,800 feet of flume system.

The location of the generating station of the Barriere hydro-electric plant was made, however, with the view to the abandonment of the present intake when the demand for power exceeds the economical maximum capacity of the combined Barriere and steam plant systems as developed, and the development of from 15,000 h.p. to 20,000 h.p. by constructing about ten miles of conduit system direct from the North Lake to the generating station to obtain an effective head of 600 feet.

Flume System

The construction of the flume system, including the intake dam, forebay, and wasteways, was started in February, 1912, the work having been let in one contract, to William Greenlees, of Vancouver.

It was planned to have the entire hydro-electric plant completed, if possible, by the end of the year, and it was therefore important to complete the construction of the intake before the high water flow of the river in May or June.

Intake.—The intake dam is a standard rock fill crib type set with a pile foundation to ensure greater stability. The site chosen enabled a suitable intake to be obtained by raising the level of the water ten feet from the normal level of the stream to the crest of the spillway, the grade of the river above this point being such that the flood level extended about 1,600 feet up stream.

The intake for the flume is located on the north side, and a logway and a fishway are placed on the other side of the spillway, the logway being 12 feet wide and the fishway built in accordance with the requirements of the Provincial Government.

The beds of the stream at the site chosen consisted of a top layer of boulders, underlaid with alternate layers of quicksand and blue clay, but a satisfactory degree of water-tightness was secured by carrying the toe sheeting down to a depth of 12 feet, with the filling of mastic and puddled clay, an earth fill being made over this and carried to a height near the spillway by an easy slope.

The foot of the spillway was carried well down stream on piling, to take care of logs and roots which might get past the boom above the dam. The work was completed without difficulty by the middle of April, and passed satisfactorily the severe test of the high water flow of the following months.

Flume

The flume is designed for an ultimate capacity of 320 cubic feet per second and is 3.4 miles in length from the intake to the forebay. In design it is the standard type of timber flume, 8 ft. wide by 5½ ft. high, built up of 2 x 10 in. fir lumber, supported every four feet, and resting on trestle or cedar sills.

The quality of the lumber available was good, but a better quality of coast fir was used for battens and flooring at those sections where water-tightness was especially desirable. Probably the only section which required special attention in this respect was a length of about 1,000 feet, two miles from the intake, where the flume was carried past a steep bank at a horseshoe bend of the river. There appeared some danger of a slide occurring at this section, either from undercutting of the banks of the river or from water running down from the melting snow or leakage of the flume.

It was desirable, however, to continue the flume, if possible, along this section, in view of the necessity of getting timber down from the mill for the construction of the system, and to avoid the heavier expense of carrying a syphon across the river, the cost per foot of the syphon being about four times the cost of the flume for an equal capacity.

The flume system, including wasteways and forebay for penstocks, was completed in the fall, and unfortunately the city was then obliged to shut down on all work on the hydro-electric plant on account of the failure to sell the balance of the hydro-electric bonds due to the financial stringency.

The system as completed was tested out, however, and found to be in satisfactory condition for service, but when the completion of the plant was carried out, two years later, it was found necessary to build the syphon at the section above referred to, on account of a slide occurring which

Fig. 3—Intake Dam, Hydro Plant, Kamloops, B. C.

carried away about six hundred feet of the flume. This syphon is built with capacity for half the ultimate capacity of the system. It is wood stave pipe construction, 66 inches in diameter, 2,100 feet long and designed for varying head to a maximum of 120 feet.

The advisability of covering the flume as a protection against snow was considered, but as the design provided for a velocity varying from 6½ to 7½ feet per second, and careful inspection was required during the first winters' operation, it was decided to leave the system open until the need of a cover could be better determined from actual experience.

Forebay

The forebay is of timber construction and located in a small depression, so that a hogsback lies between the forebay and the power house as a protection against accident to the water system. Its general dimensions are 18 ft. by 36 ft. long and 12 ft. deep, with ample provision for overflow to a wasteway down a small ravine to the river.

Penstocks

There are two 42-inch penstocks from the forebay to the power house, each 490 feet in length. They were built by the Vancouver Wood Pipe and Tank Company and are of wood stave pipe construction with staves 2½ inches thick and steel bands of ½ in. to ¾ in. diameter, spaced for pressure head from 30 ft. to 210 ft. Each penstock was connected up with its turbine by 28 feet of steel riveted pipe, anchored in concrete and connection between the wood stave and steel pipes was made by an expansion joint.

Generating Station Building

As already noted, the location of the generating station was governed not only by the plans for the present development, which can be brought up to at least 5,000 h.p., but the prospect of a future development of from 15,000 h.p. to 20,000 h.p. by a conduit system direct from the North Barriere Lake was also considered.

At the site chosen, the sub-surface conditions of alternate layers of gravel, quicksand and blue clay, required that the entire foundations of the building should rest on piles, and these were driven to an average depth of about 30 feet to secure a firm support.

The entire structure was built of reinforced concrete, the details for the tailrace and supporting walls, and beams for the units requiring considerable form work. The sand and gravel for the concrete was obtained close by the plant, and there were no unusual features of construction worthy of special mention.

The accompanying plan and elevation of the building show the general arrangement and some details of construction. The building as completed is intended to form half of the final structure, the construction of the other half will be carried out when other units are required.

The present dimensions are 45 feet by 48 feet, making the structure, when extended, 45 ft. by 96 ft. It will be noted on referring to the plans that the arrangement for the installation of the equipment is fairly compact, although the high tension equipment is well separated from the other section. The construction of the generating station was carried out by Wm. Greenlees, of Vancouver.

Sub-Station, Steam Plant and Pumping System

The power line from the Barriere plant is brought across the South Thompson to the steam plant building, located near the river at the eastern limits of the city. The main building is of reinforced concrete construction and is about 90 x 75 feet in ground area. It is divided into three bays, consisting of boiler room, turbine room and high tension sub-station. In the basement at the extreme west end is located a reservoir from which the waterworks pumps take their suction. This basement also contains the condenser and condenser auxiliary. The basement under the turbine room is on the same level as the boiler room floor and the well for the pumps is connected by some six hundred feet of 16 in. mains to the pump house at the river's bank.

The architectural features of the building have been carefully thought out in order to furnish a substantial structure with ample lighting and good ventilation. The roofing over the boiler room is supported by trusses, while that over the turbine room and switchboard is supported by deep web I-beams. The horn gap structure for the high tension lines allows them to come in through the roof cones, well within the confines of the plant.

The reservoir into which the water is pumped is located in the Beckman addition, about a mile away from the plant. There are large mains leading to it with frequent laterals for supplying the various sections of the town. When water is being drawn from the laterals, the head under which these pumps operate is somewhat modified, but it is usually kept within from 320 to 340 feet, depending upon the quantity of water being taken out of the system.

The discharge from the waterworks pumps is measured by a Simplex Venturi meter, located just outside of the building wall, the recording and integrating apparatus being placed in the corner of the turbine room.

Auxiliary Pump House

The auxiliary pump house, located out on the river, contains two vertical centrifugal pumps operated and driven by vertical motors, which are above the highest possible known water level. This pump house is constructed of concrete, and so arranged as to admit water to the inside of the house through long intake pipes connecting the house with a screened inlet located in the middle of the river. The inlet pipes terminate in gate valves hand operated from the motor floor level. These pipes discharge into a separate chamber in which a secondary double system of screens are installed which prevent to a large measure foreign matter getting

Fig. 4—Flume System, Hydro Plant—Kamloops, B. C.

Fig. 5—66" Wood Stave Pipe Syphon, Kamloops Power Plant.

into the system. Beyond these screens there has been constructed provision for stop logs which will serve as an auxiliary means of permitting access to the pumps for cleansing or repairs, should anything prevent the use of the main gate valves for the purpose of shutting off the water.

The pump house is of concrete, heavily reinforced throughout. The water comes through grizzlies or screens into the base of the pump house, and is there handled by the vertical centrifugal pumps. These discharge the water through the 16-in. main above mentioned.

The pumping system is so arranged that the filter beds can be later constructed in the space between the auxiliary pump house and the main pump house. These filter beds are to be of the gravity type and of such elevation as to allow the discharge from the auxiliary pump house to run through the filter beds and then by gravity to the reservoir in the basement of the pump house.

The pumps at the auxiliary pump house are operated from the main switchboard, one of them being operated by standard hand operated starter and the other by an automatic patent starting device controlled by a float switch. This device maintains the water in the reservoir forming the suction chamber for the main pumps at a given level. It is found that by proper regulation of the inlet valves this automatic pump is kept in practically uniform service though its arrangement will permit of its starting and stopping to automatic control at the level in the reservoir.

Engine Room Crane

In order to provide means for readily handling all parts of the power plant machinery a ten-ton hand operated travelling crane has been provided which runs over the entire turbine and pump room. By this means any of the machinery can be readily transmitted for the purpose of inspection or repairs. By means of transfer cars the transformers can be wheeled out under the crane to facilitate handling their cores for inspection or repair should occasion demand.

Contracts

The construction of the main building and pump house was carried out by Messrs. Johnson & Gill, of Kamloops, and the installation of the complete plant equipment was carried out by Messrs. C. C. Moore & Company, of Seattle, and included turbines, units, motors for pumps, and complete switchboard equipment supplied by the Canadian General Electric Company.

Reservoir

The new reservoir has a capacity for 1,500,000 Imperial gallons and is located south of the eastern part of the city, between Eighth and Ninth Avenues at an elevation of 30 ft. head above the river. The 14-in. steel main running up Ninth Avenue connects westward with the old power station through the city distributing system, and eastward through a 14-in. and 16-in. main with the new power and pumping station. This main is lapwelded with Matheson joints and in addition to the regular coating has an extra wrapping of burlap as a protection against the strong alkaline action of the soil peculiar to the district.

The design decided upon was a totally enclosed reinforced concrete type with interior dimensions 160 x 96 feet, and a depth of water of 15 ft. 6 in. at the eastern end. The roof consisted of a four-inch slab resting on a beam work supported on square columns 16 ft. centres each way. The floor has a slope eastward of one foot in its length, and as the columns were all the same length the roof had a similar grade.

The first layer is 4½ in. and was poured before any forms were erected, and had embedded in it No. 26 mesh. After the forms had been removed the final layer 4 ins. thick of selected materials was put on without any particular bond with the first floor beyond carefully washing it down. No mesh was laid on the final layer and ⅜ x ¼ in. "V" joints were left about ten feet from the walls after each day's work. This floor and the wetted area of all walls, which were purposely left rough, was given a plastered coat of 1:1½ well trowelled in, on which was put a glazed finish of neat cement and water. The "V" joints were then poured with hot asphalt. Expansion joints divide the walls vertically into sections about 32 feet long. These were formed by allowing no special bond between sections, apart from a dovetail and a 16-in. gauge copper strip with a ½ in. "V" notch across the joint.

All reinforcement was lapped at least thirty diameters to form the splice. Concrete 1:2½:5 mix was used in the rough floor and all footings, and 1:2:4 mix elsewhere, excepting the plaster coat of 1:1½.

On September 24th, 1911, the reservoir was put into permanent commission. The wisdom of putting in the expansion joints was apparent as cracks soon appeared in the walls, which were in every case isolated at those joints and rendered harmless by the copper strip and subsequent plaster coat. An examination six weeks later showed no traces whatever of leakage, all drains being perfectly dry.

Economics of the Power Plants Systems

On the completion of the above projects the total expenditure was found to be about $550,000, of which $295,000 would be chargeable to the hydro-electric plant, $130,000 to the steam plant and $135,000 to the waterworks system, including the pumping plant and reservoir.

Hydro-Electric Plant

An additional expenditure of $25,000 was made on the hydro-electric plant for the construction of the syphon on the flume system, and the overhauling of the flume after the two years' delay in completing the plant, and all or part of this should be charged to annual maintenance. This charge added to the capital cost would bring the expenditure of the hydro-electric plant to $320,000, or $160 per h.p. installed.

Engineering

The engineering of the several projects included in the systems described and which were intended to form a complete scheme for future development was carried out under the direction of the writer as Consulting Engineer, and his firm, Messrs. Ducane Dutcher & Fergusson, ably assisted by members of the staff, including Messrs. N. M. Hall, W. E. McLean, and H. A. Daubner.

Trade Publications

Asphalt Plant—descriptive catalogue issued by the Warren Brothers Company, Boston, Mass., manufacturers of all kinds of asphalt paving plants, machinery and tools, illustrating and describing their equipment.

Cement Belts—Bulletin 102, issued by the Cement Gun Company, Inc., 30 Church Street, New York, entitled "Cement Gun on the Elephant-Butte Dam, New Mexico," being a reprint from an article in the Engineering News of September 30, 1915, by E. H. Baldwin. The same company have issued bulletin No. 91—another reprint from the Engineering News, entitled "Tunnel Waterproofing with Cement Clay Mortar."

Trade Inquiries

214. **Builders' supplies**—A Cape Town firm, with representatives covering all centres in the Union, asks for quotations on asbestos cement sheets, plumbers' supplies, closet seats, brass taps, three-ply board and school-boards, black and green surface.

227. **Metal ceilings.**—A Newfoundland firm desires to form connection with Canadian manufacturers of metal ceilings for dwelling houses and stores.

Personal

Mr. Charles L. Marble has been appointed secretary and manager of the Wayne Oil Tank and Pump Company, of Woodstock, succeeding F. R. Haven.

Lieut. Eric G. Kingwell, late city engineer, Kamloops, B. C., is making a recruiting tour through the Boundary and Kootenay districts to stir up interest in the Pioneer battalion.

Mr. A. Blair Ripley, who has had charge of the C. P. R. grade separation work at Toronto, has been appointed to command a construction battalion with the rank of Lieutenant-Colonel. The battalion will be composed of men engaged in bridge building, railway construction, roadwork and general construction for overseas service. Mr. Ripley is a member of the Canadian Society of Civil Engineers.

Mr. George McKnight, the new city engineer of Fredericton, N. B., after many years of engineering experience, returns to his native town. Mr. McKnight was born in Fredericton in 1879, and qualified himself for his profession by special courses in military engineering. He started out as chain man on a land surveying party in the province of Quebec; later was rod man on the National Transcontinental Railway; was raised to level in 1905; passed through all the promotion stages, until in 1907 he was appointed resident

Mr. George McKnight.

engineer, which position he held throughout the entire construction of that work. In 1911 he became construction engineer for J. H. Corbett Company, and was at various times in Butlar City, Pa., Wheeler, Va., and Knoxville. Toward the end of the same year he returned to Canada to act as locating engineer for the I. R. C. in Nova Scotia, and early in 1912 entered the employ of the St. John and Quebec Railway Company, which position he resigned on April 15, 1916, to take up his duties as city engineer of Fredericton.

At the annual meeting of the National Brick Company, Montreal, it was reported that while the brick business for the fiscal year ending February 29 was just about as dull as the previous year, there has, however, been some improvement within the past month or two. It is expected that the Ontario National Brick plant, near Toronto, will resume operations shortly, having closed down since the latter part of 1914.

Mainly Constructional

East and West—From Coast to Coast

F. E. Maxwell & Company, contractors, Montreal, Que., have registered.

Builders and Contractors, Limited, Winnipeg, Man., have been incorporated.

The Manitoba Plumbing Company, Limited, has been incorporated with a capital of $5,000, head office at Winnipeg, Man.

Building permits were issued at St. Catharines, Ont., for buildings at an estimated cost of $78,775 during the month of April.

The Fowler Machine Works, Limited, has been incorporated with a capital of ten thousand dollars; head office Vancouver, B. C.

At the annual meeting of the shareholders of the Alberta Sewer Pipe Company, Calgary, P. Turner Bone was re-elected president.

Hon. Mr. Macdiarmid, Minister of Public Works, has decided to adhere to the original Lake Shore route for the Toronto-Hamilton highway.

Building permits in the city of Hamilton, Ont., up to March 31 of this year, total $162,215. This is a decrease from the same period last year of $9,260.

To replace the plant of the Dominion Harvester Company, Medicine Hat, Alta., recently destroyed by fire, a complete new equipment has been ordered.

Building operations in Amherst, Ont., are practically at a standstill. It is stated that as yet there has not been a single house contracted for this season.

Completed plans for the proposed highway work to be done in San Diego County, Cal., under the bond issue which is to be voted upon May 16, involve the expenditure of $2,101,000.

Figures published in the 1915 annual report of the Bureau of Labor show that building permits throughout Ontario declined from 26,253 in 1914 to 21,318 in 1915, and the total cost fell from $68,824,692 to $33,316,942.

In the city of Toronto there were 382 building permits issued during the month of April, representing a total cost in buildings of $457,271, as compared with 193 in the month of March, representing a total cost of $272,240.

The Alberta Farmers' Co-operative Elevator Company have awarded a contract to the Thomas-Jamieson-McKenzie contracting firm of Calgary, to erect seven standard-size elevators in the northern portion of the province.

The Engineers Club, Thorold, Limited, has been incorporated with a capital of $40,000, head office at Thorold, Ont. The object of the company is the promotion of social intercourse and mutual benefit and friendship amongst its members.

The Miramichi hospital at Newcastle, N. B., will be opened next month to the public. This building has a frontage of 144 feet, with an average width of 40 feet. It is a splendidly equipped building, and was erected at a cost of $90,000.

A million-dollar mail order building may be erected by the T. Eaton Company in Toronto. The company are negotiating with the city authorities to obtain for the site an area of land on the lake front from Bay Street to Yonge Street, and it is hoped that the deal will be closed at an early date. The T. Eaton Company are to obtain a lease of the property for 21 years, the rent of which will be $25,000 per annum.

Roadmaking is going on at Niagara camp under the supervision of Lieutenant J. S. McMurray of the Engineer Corps, in preparation for the opening of the camp on the 15th. A new water supply system is also being installed.

Negotiations for the establishment of a new steel plant in Selkirk, Man., are under way. The details in connection with the site have been settled, which is to be on a block of land adjoining the Manitoba Roller Mills. The structure will be of steel.

There has been great activity in building circles in Quebec, P. Q., recently. A large number of building permits have been issued, amongst them being included one to Hon. George E. Amyot for the erection of a $50,000 factory on St. Helene Street.

Trouble was experienced recently in Montreal when the bank of the canal gave way and the water threatened to undermine the city water mains and sewer. It is planned to face the banks with concrete on a solid concrete trench at the bottom of the canal.

Building permits at Welland, Ont., for the month of April this year amount to $20,086, as compared with $10,452 for the same month last year. Total for this year up to the end of April is $30,124, while for the corresponding period last year it was $55,032.

Work on the new C. P. R. station at Quebec, P. Q., is progressing rapidly. One suite of rooms is already completed for the use of the passenger departments. The roofing is practically finished, and it is expected that the whole station will be completed by July.

Chairman Smithers, of the Grand Trunk Railway Company, has written to Premier Borden, suggesting that the Dominion Government take over the Grand Trunk Pacific Railway owing to the inability of the company to meet the debts and deficits on that system.

The city of Charlottetown, P.E.I., propose to install a low lift pumping station, to deal with a million gallons of water per day. The pumps will be driven by oil engines and will distribute the water to the reservoirs. The consulting engineers are R. S. and W. S. Lea, Montreal.

Mr. John Kerr, founder of the firm of J. & J. Kerr, builders and contractors, Petrolea, Ont., died on the 18th inst. He was born in Bonhill, near Glasgow, Scotland, in 1841, and came to Canada in 1847. Mr. Kerr was also largely interested in the refining and production of petroleum.

The United States Government has taken objection to the proposed Chippewa Creek diversion plan for the development of power at Niagara, and have sent a note to the Ontario Government regarding the same, suggesting that the matter be referred to the International Joint Commission for investigation.

A new steel bridge is to be built at Nanaimo, B. C., at an estimated cost of about $5,000, to connect Newcastle Townsite and the main business section of Nanaimo. The City Council have decided to purchase two steel spans which were used in the old Granville Street bridge, Vancouver, for use in its construction.

The old bridge at the foot of Bathurst Street, Toronto, is to be torn down immediately, and a new one erected on the same site, built on concrete abutments resting on bed rock. With the exception of the abutments the bridge is to be entirely of steel. It will have a clearance of 22 feet over the railroad tracks below. It will probably be completed by July of this year.

For the month of April this year the number of building permits issued in the city of Montreal is 220, representing a value of $428,530, as compared with 312 in April, 1915, representing a value of $973,891. There were 438 permits issued up to April 30 this year, value $911,950, while for the same period last year there were 666, value $1,865,827.

The Provincial Lime Company, Limited, with headquarters at Brookville, N. B., have been granted letters patent. The promoters are H. A. Allison, G. E. C. Gandy, R. D. Paterson, S. G. Olive and Harry E. Reardon, all of St. John. The purpose of the company is to carry on a general business of quarrying and manufacturing limestone and all of its products.

The special committee of Parliament formed to pass upon the plans for the reconstruction of the Parliament Buildings, Ottawa, have decided to follow the general plans as submitted by Architects Pearson and Marchand, of Toronto and Montreal. There will be a few minor changes, and it is expected that the contract will be let almost immediately for a sum in the neighborhood of $1,500,000.

Since the first of the month eleven building permits have been issued at the city hall, Peterboro. The value of new buildings represented is about eighteen thousand dollars. The chief among the list is a permit authorizing the erection of an addition to the plant of the Bonner-Worth Company, on McDonnell Street, at an estimated expenditure of ten thousand dollars.

Eighteen tenders were submitted to the Toronto Harbor Commission for the construction of a concrete harbor headwall and cribs, part of the harbor development work from Bathurst to Brock Streets. It has been decided by the Commissioners to award the contract to R. Weddell Company, providing the tenders are in compliance with the specifications, on which report has yet to be made. Some portion of the contract will also probably go to the Russell Company, of Toronto. The whole work, which is to be commenced at an early date, will cost approximately $250,000.

Big structures to cost over $7,000,000 are in the building programme of Toronto, Ont., for the spring and summer. The following is a list of building permits which have been issued or will probably be issued shortly:—

Union Station	$3,400,000
Customs House	1,500,000
Robert Simpson Company warehouse ...	500,000
T. Eaton Company warehouse	500,000
Robert Simpson Company dormitories..	200,000
Princess Theatre	100,000
T. Eaton Co. 4-storey stable	100,000
Majestic Theatre (changes)	50,000
T. Eaton Co. mail order building	1,000,000

The Jefferson highway proposition received hearty endorsation at a recent meeting of the Manitoba Good Roads Association, to which representative men of the city of Winnipeg had been specially invited to consider the question. Mayor Waugh, who seconded the motion put by the Hon. Thomas H. Johnson, Minister of Public Works, emphasized the great advertising value to Winnipeg and the West which would accrue from such direct communication with the whole of the American continent. The Jefferson highway will thus connect Winnipeg with New Orleans, which road will cross a transcontinental, running east and west, and called the "Lincoln," at Des Moines.

The formation of the Fitzhugh-Crowley Corporation, engineers, constructors, and railway specialists, with offices at 60 Broadway, New York, is announced. Mr. E. H. Fitzhugh, the president of the corporation, was formerly vice-president of the Grand Trunk Railway Co., and president and general manager of the Central Vermont Railway. In these capacities he took a prominent part in the great development of railroad facilities in Canada in recent years. Associated with him is Mr. Charles J. Crowley, well known in Toronto, and a railroad engineer of long standing reputation. Mr. Crowley will act as vice-president and chief engineer of the newly formed corporation

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Aylmer, Que.
Plans for the proposed filtration plant are being prepared by F. Meddles, care of Montreal Power Company, Montreal. Approximate cost, $25,000.

Dundas, Ont.
The by-law authorizing the construction of concrete sidewalks at an approximate cost of $5,500 has been carried. The other by-laws for sewers and sewage disposal plant were defeated. Town Clerk, J. S. Fry.

Grand Prairie, Alta.
The Village Council have had plans prepared for a water supply to be taken from Bear Creek.

Markham, Ont.
The Village Clerk, M. White, will receive tenders until May 15th for the construction of approximately 35,000 square feet of concrete sidewalk according to city of Toronto specifications.

Orford Township, Ont.
The Township Clerk, F. Littlejohn, Highgate, will receive tenders until May 20th for the construction of the Butler Drain.

Ottawa, Ont.
The City Council are having plans prepared for asphalt pavement, gutter and catch basins to be constructed on Hinton Avenue. Approximate cost, $8,000. Engineer, F. C. Askwith.

St. Foye, Que.
The Municipal Council propose to expend $15,000 on sidewalks and $100,000 on macadam roads during the season. Secretary, P. N. Robitaille.

Sudbury, Ont.
The Town Council propose to lay bitulithic pavement on a portion of Station Street. Clerk, W. J. Ross.

Tilbury, Ont.
The Town Council are considering the laying of pavement on a number of streets. Clerk, W. H. Hutton.

Tillsonburg, Ont.
The Town Council are considering the laying of crushed stone on the roads at an approximate cost of $5,000. Clerk, A. E. Raynes.

Toronto, Ont.
Works Commissioner Harris has recommended the construction of asphalt pavement to cost about $15,800, and wood block pavement to cost $6,880.

Wellesley Township, Ont.
Tenders on the construction of the Hahn Drain will be received until May 20th by the Township Clerk, Peter Schummer, St. Clements.

CONTRACTS AWARDED

Essex, Ont.
The Town Council have awarded the contract for the supply of one deep well pump, one fire pump and motors to Canadian Allis-Chalmers, limited, 212 King Street West, Toronto. Approximate cost, $3,050.

Ingersoll, Ont.
The Town Council have awarded the contract for the construction of pavements during the year to the Municipal Concrete Construction Company, at 10c per square foot.

North Bay, Ont.
The Town Council have let a contract for the construction of sewers to C. Sandreldi. Approximate cost, $3,500.

Ottawa, Ont.
The City Council have let the contract for the supply of a quantity of watermain to the National Iron Works, Limited, Cherry Street, Toronto.

The contract for supply of sidewalk forms has been let by the City Council to Mussens Limited, 318 St. James Street, Montreal.

Railroads, Bridges and Wharves

Howick Township, Ont.
The Township Clerk, Mrs. C. E. Walker, Gorrie, will receive tenders until May 17th for concrete abutments for two bridges.

Jacquet River, N.B.
Tenders will be received until noon, May 17th, by Hon. John Morrissy, Minister of Public Works, Fredericton, for the superstructure and approaches of a proposed bridge. Plans and specifications at the Provincial Rooms, St. John, and with D. McAllister, Jacquet River, and D. Stewart, M.L.A., Campbellton.

Lobo Township, Ont.
Tenders on the construction of a steel bridge for the Township Council will be received until May 27th by the Engineer, Charles Talbot, London. Estimated cost, $10,000.

Quebec County, Que.
The construction of an electric railway, estimated to cost $150,000, is being considered by the Quebec Railway, Light & Power Company, Quebec.

Public Buildings, Churches and Schools

Amherst, N.S.
The Town Council propose to remodel the County Academy and install a heating system. Clerk, W. F. Donkin.

Brampton, Ont.
Revised plans are to be prepared for the proposed addition to the Sunday School of the Methodist Church, and new tenders will be called. Architect, Hartley Galloway, 79 Adelaide Street E., Toronto. Approximate cost, $10,000.

Calgary, Alta.
The Hospitals Board are considering the erection of an addition to the General Hospital to accommodate 100 nurses. Approximate cost, $60,000.

Dundas, Ont.
The by-law to authorize the erection of a High School at an approximate cost of $35,000 has been defeated.

Haileybury, Ont.
The High School Board will receive tenders until May 15th for the erection of the School of Mines Building. Plans and specifications at office of the Secretary, J. H. Shibley, Box 179, and at the T. & N. O. Station. Approximate cost, $20,000.

Hazenmore, Sask.
The Trustees of School District 3225 have been empowered to borrow $6,000 for the erection of a two-roomed brick school. Treasurer, H. Whiteley, Hazenmore.

London, Ont.
The Trades & Labor Council propose to build a Temple at an approximate cost of $45,000, and will have plans prepared. Particulars from James Hussley, 241 Colborne Street.

McGregor, Ont.
The Catholic Trustees are considering the erection of a school, at an approximate cost of $10,000. Particulars from Father J. A. Pinsonneault.

Ottawa, Ont.
The Department of Public Works have included in their supplementary estimates the sum of $240,000 for a new roof for the East Block. Secretary, R. C. Desrochers.

Portage La Prairie, Man.
The by-law to authorize the raising of $64,500 for the erection of a school has been defeated.

St. Raphael D'Aston, Que.
Work is about to start on the erection of a Presbytery for the Parish. The general contract will probably be let to La Cie. Ouvriere, St. Raphael d'Aston. Approximate cost, $8,000. Architects, Louis Caron & Fils, Nicolet.

Swanson, Sask.
The Trustees of Knight School District 1756 have been authorized to borrow $6,000 for the erection of a school. Treasurer, W. G. Grigg, Swanson.

Tavistock, Ont.
The ratepayers have authorized the $9,000. Tenders will probably be called shortly. Architect, J. S. Russell, 21 Downie Street, Stratford.

Victoria, B. C.
The School Board are having plans drawn for a school to be built on King's

Road, at an approximate cost of $25,000. Architect, C. E. Watkins, Green Block. Brick construction.

CONTRACTS AWARDED

Cochrane, Ont.
The general contract for the erection of a school has been let to Oliver, Edward & Company, care of W. D. McDouglas, Secretary to the School Board. Approximate cost, $40,000. Architects, Angus & Angus, North Bay.

Dover Township, Ont.
The contract for masonry, carpentry, plastering and painting required in the erection of the Presbyterian Church has been awarded to Harry Rayment, 155 Grand Avenue W., Chatham, at $4,813.

Havre au Bouche, N.S.
The contract for exterior work required in the erection of a church for the Roman Catholic Congregation has been awarded to Landry & McGillivray, Antigonish. Approximate cost of building, $25,000.

Kingston, Ont.
Work has been started on the erection of a school for the Public School Board, and the plumbing contract has been let to Taylor Brothers, Almonte.

Montreal, Que.
The contract for carpentry required in the erection of a Presbytery for Ste. Catharine Parish has been let to R. Marsolais, 319 Beaudry Street, the roofing, heating and plumbing to T. Lessard & Sons, Ltd., 191 Craig Street E., plastering to J. Chamberland, 553 Durocher Street, and electrical work to L. Ortiz, 376 Fabre Street.

The general contract for the erection of a Presbytery for the Trustees of Ste. Catherine Parish, 408 Amherst Street, has been awarded to O. Archambault, 610 Parc Lafontaine Street. Approximate cost, $28,000.

The general contract for the construction of a basement for the proposed Church of St. Peter and St. Paul has been awarded to Prima Corbeil, 382 Fabre Street.

Mt. Dennis, Ont.
The following contracts have been let in connection with the school now being built for the Trustees of School Section 28:—roofing, W. E. Dillon Company, Limited, 183 George Street, Toronto; terrazzo floors, Italian Mosaic & Marble Company, College Street, Toronto; electrical work, W. F. Moon & Company, 1724 Dundas Street, Toronto; painting, Fell Brothers, 44 McMurray Street, Toronto.

Ponteix, Sask.
The general contract for the erection of a church and rectory for the Roman Catholic Congregation has been awarded to the Poole Construction Company, Limited, Smith and 12th Streets, Regina. Approximate cost, $20,000.

Quebec, Que.
The Commercial Academy, Cook St., have awarded the general contract for the erection of a College on Chauveau Street to Jinchereau & Lamonde, 325 Richardson Street, at $260,000.

St. Antoine de Bienville, Que.
In connection with the erection of the Parish Church, the masonry contract has been let to Paquet & Godbout, St. Hyacinthe.

In connection with the Parish Church, the carpentry contract has been let to Paquet & Godbout, 21 William Street, St. Hyacinthe, painting to O. Lachance, 25 Eden Street, Levis, and electrical work to P. P. Giguere, 55 Des Fosses Street, Quebec.

St. Evariste de Forsythe, Que.
The general contract for the erection of a school has been awarded to Albert Langelier, St. Victor de Trung. Approximate cost, $10,500.

St. Therese, Que.
The contract for the erection of a convent for the Rev. Sisters of the Congregation Notre Dame has been let to Beausejour, Letourneau & Company, Grand'Mere, Que. Brick, stone and concrete construction. Estimated cost, $56,000.

Toronto, Ont.
The Separate School Board have let the following contracts in connection with St. Monica's School:—masonry, M. Manley, 1058 College Street; carpentry, D. & M. J. Madden, 552 Adelaide Street W.; roofing, A. Ryan, 962 Bathurst St.; steel work, McGregor & McIntyre, 1139 Shaw Street; plumbing, W. J. McGuire, Limited, 91 James Street; heating, T. E. Regan, 95 Booth Avenue.

The following contracts in connection with the addition to St. Peter's School have been let by the Separate School Board:—masonry, John McGloe, 285 Sherbourne Street; carpentry, D. & M. J. Madden, 552 Adelaide Street West.

Business Buildings and Industrial Plants

Aylmer, Que.
The Fair Association contemplate the erection of Fair Buildings, estimated to cost $4,000. Secretary, F. Duma.

Banff, Alta.
Harold S. Johnston has been appointed Architect for the proposed block to be erected on Banff Avenue for R. G. Brett. Estimated cost, $20,000.

Barriefield, Ont.
The Department of Militia have received tenders on the erection of a number of frame buildings at the Camp. Approximate cost, $16,000.

Crampton, Ont.
John Jenkins, Avon Gravel Road, Ingersoll, is considering the erection of stock barns and a residence, estimated to cost $4,500.

Dresden, Ont.
Thomas Pavy has commenced the erection of stock buildings, estimated to cost $3,200. Steel and cement construction.

Greenock, Ont.
Andrew Watson, R. R. No. 1, Paisley, is preparing plans of a stock barn, to cost about $3,000. Frame and concrete construction.

Halifax, N.S.
Bonds Limited, Barrington Street, are having plans prepared for remodelling a restaurant building, estimated to cost $20,000. Architect, S. P. Dumaresq, St. Paul Building. Reinforced concrete and brick construction.

Hamilton, Ont.
George Hill, 21 Vine Street, is receiving tenders on steel work and roofing required in connection with the stable which he is building.

Malden Township, Ont.
Ernest Shaw, Concession 3, Amherstburg, Ont., will shortly commence the erection of a stock barn. Estimated cost, $3,000. Frame and concrete construction.

Montreal, Que.
Thomas Lamb, Architect, New York, is preparing plans for a theatre to be built for G. Rabinovitch, 532 St. Lawrence Boulevard. Approximate cost, $250,000.

H. Morgan & Company, 16 Beaver Hall Hill, are about to erect a garage, estimated to cost $10,000. Brick and concrete construction.

New Hamburg, Ont.
Work has been started by H. Deichert on the erection of an addition to a store, estimated to cost $3,000. Brick and concrete construction.

Ottawa, Ont.
The Burrows Refining Company, 629 Wellington Street, are about to commence the erection of a nickel refinery, estimated to cost $6,000. Ironclad and frame construction.

Prince Edward Island, Ont.
William Lockhart, Ruscomb, Ont., is considering the construction of a plant for the manufacture of brick and tile. Estimated cost, $10,000.

Quebec, Que.
E. Julien & Company, 1230 St. Valier Street, have commenced the erection of a store, estimated to cost $3,000. Brick and concrete construction.

Work has been started by Bedard & Kippan, 12 Cartier Avenue, on the erection of a theatre on St. John Street. Estimated cost, $6,000.

St. Clothilde, Que.
Omer Bergeron is about to start work on a sawmill, estimated to cost $5,000. Frame and metal construction.

Sudbury, Ont.
V. L. Morgan is preparing plans for stores to be erected for J. P. Coulson. Brick and concrete construction. Approximate cost, $4,000.

Toronto, Ont.
W. G. Hunt, Architect, 12 Queen St. E., is preparing plans for two stores to be erected on St. Clair Avenue W., at an approximate cost of $6,000. Tenders will be called shortly. Brick construction.

C. J. Gibson, Architect, 53 Yonge St., will receive tenders until May 13th on all trades required in the erection of an office and warehouse for William Long, 406 Yonge Street. Brick and steel construction. Approximate cost, $25,000.

The Sun Beam Lamp Company, Dufferin Street, have had plans prepared for a storage building, to cost about $17,000. Brick and steel construction.

The Board of Control will receive tenders until May 23rd for the erection of an addition to the St. Clair Avenue Car

Barns, estimated to cost $25,000. Steel and frame and brick construction. Plans at Room 311, City Hall.

Plans have been prepared for an addition to the premises of the McClary Manufacturing Company, 177 King St. W. Brick construction. Approximate cost, $3,500.

The T. Eaton Company are negotiating with the Harbor Commissioners for a site for the erection of a warehouse. Estimated cost, $1,000,000.

The Toronto Harbor Commissioners are building a machine shop, estimated to cost $15,000. Corrugated iron and brick construction.

Whitby, Ont.
John T. Hornsby is preparing plans for two stores to be built on Brock Street for W. J. H. Richardson. Fireproof construction. Estimated cost, $5,500.

Windsor, Ont.
G. Jacques & Company, Boug Block, will receive tenders until May 30th for the erection of a block of stores and flats on Dougal and Pitt Streets for Herman Benstein, 132 Goyeau Street. Brick and concrete construction. Estimated cost, $20,000.

Winnipeg, Man.
The Department of Public Works, Ottawa, have included in their supplementary estimates the sum of $500,000 for the erection of a grain elevator.

CONTRACTS AWARDED

Halifax, N.S.
The contract for all work except plumbing and electrical work required in alterations to a theatre for the Academy of Music, Limited, has been awarded to S. M. Brookfield Limited, 58 Granville Street. Approximate cost, $30,000.

The contract for brick work required in the construction of a gas plant for the Halifax Electric Tram Company has been awarded to MacKenzie & Murphey, Sydney, N. S., and the contract for supply of about 1,000,000 brick to the Nova Scotia Clay Works, Ltd., Halifax.

Hamilton, Ont.
In connection with the erection of an addition to the premises of the Zimmerman Manufacturing Company, the contract for roofing has been awarded to John Riddle & Son, 12 Ferguson Avenue N., heating and plumbing to W. J. Walsh, 215 King Street E., and electrical work to Snyder Brothers, 37 King William Street.

Maisonneuve, Que.
The general contract for the erection of an office and residence for Abel. Fortin & Cie., Desjardins Street, has been let to Arsene Croquette, 170 Bourbon Street. Brick construction. Approximate cost, $3,500.

The general contract for alterations and additions to an office and factory for the Columbus Rubber Company, 146 Iberville Street, has been awarded to A. Gratton Limited, 142 Fifth Avenue, Maisonneuve. Brick and concrete construction. Estimated cost, $20,000.

The general contract for the erection of an office and store building for the Grand Trunk Railway Company has been awarded to E. Garrigan, 218 Ballantyne Avenue, Montreal West. Estimated cost, $3,500.

The contract for mill work required in the erection of an addition to the exchange of the Bell Telephone Company has been let to William Rutherford & Sons Company, Atwater Avenue.

Montreal, Que.
The contract for ventilating and heating in connection with the emergency hospital now in course of erection for the Montreal Locomotive Works, Ltd., has been let to L. E. Moulton & Company, Limited, 142 Inspector Street.

New Glasgow, N.S.
The general contract for the erection of a theatre for McNeil & Smith has been awarded to R. L. Olding, Forbes Street. Steel, concrete and brick construction. Approximate cost, $25,000.

McCulloch & King have let the general contract for the erection of a theatre to J. D. Grant, Nelson Street, and work has started. Brick, concrete and steel construction. Estimated cost, $25,000.

Niagara Falls, Ont.
In connection with the erection of a garage for M. H. Buckley, 20 Ontario Avenue, the contract for asbestos roofing has been let to the Canadian H. W. Johns-Manville Company, 19 Front St. E., Toronto. This was previously reported as being a contract for tar roofing.

Ottawa, Ont.
The contract for tile work required in alterations to premises for G. P. Matthewman, 130 Sparks Street, has been let to the Ottawa Tile & Mosaic Company, 298 Laurier Street, painting to W. J. Carson, 293 Laurier Street W., heating and plumbing to Holloway & Sons, 373 Somerset Street, and electrical work to W. R. McCallum, 525 Bank Street.

Outremont, Que.
J. Marquis, 2655 Esplanade Avenue, has commenced the erection of a store and residence for Hector Godin, 147 Fairmount Street W. Brick and stone construction. Approximate cost, $15,000.

Peterboro, Ont.
The contract for electrical work required in connection with the addition to the premises of the Bonner-Worth Company has been let to Alexander Miller, George Street.

Preston, Ont.
The general contract for an addition to the premises of the Solid Leather Shoe Company has been let to R. Gatehouse. Pressed brick construction. Approximate cost, $25,000.

Quebec, Que.
In connection with the premises in course of erection for La Cie. De Lithographie Ltd., the masonry has been let to E. Frenette, 86 Cremanzie Street, roofing to O. Barbeau, 154 Franklin St., and carpentry to the general contractor. Heating, plumbing and electrical work will be sub-let by owners.

In connection with the stock yards now being constructed for the Quebec Abattoir Company, Limoilou, the contract for roofing, plastering, painting and heating has been let to E. Falardeau, 308 Queen Street, plumbing to F. Gingras, 36 St. Augustin Street, and electrical work to Goulet & Belanger, 237 St. Joseph Street.

The general contract for the erection of a store and residence for G. Lepine, 281 St. Valier Street, has been let to T. Mathieu, 109 Third Street, Limoilou, and work has been started. Frame and brick construction. Approximate cost, $4,000.

Saskatoon, Sask.
The general contract, masonry, carpentry, steel work, roofing, plastering and painting for the erection of a store for A. Syman have been awarded to A. W. Cassidy & Company. Heating, plumbing and electrical work will be sub-let. Approximate cost, $3,500.

Stamford Township, Ont.
The American Cyanamid Company, Niagara Falls, have let the general contract for the erection of their plant to Snyder & Gulett, 594 Ferry Street, Niagara Falls South. Approximate cost, $20,000.

Steelton, Ont.
The general contract for the construction of a shell cutting building for the Algoma Steel Corporation has been let to R. Gibson, 329 Albert Street. Approximate cost, $12,000.

Sudbury, Ont.
In connection with the business block now being built for F. M. Stafford, Durham Street, the contract for steel has been let to McGregor & McIntyre, Shaw Street, Toronto, and the heating, plumbing and electrical work to the Cochrane Hardware Company, Durham Street. The masonry, carpentry, roofing, plastering and painting have been let to the general contractors.

Three Rivers, Que.
The general contract for an addition to the mills of the Wayagamack Pulp & Paper Company, Limited, has been awarded to Nobert & Dugee, St. Georges Street. Brick construction. Approximate cost, $11,000.

Toronto, Ont.
The contract for masonry required in the rebuilding of the Princess Theatre has been awarded to S. Young, Jr., St. Clair Avenue W. Carpentry and concrete work by general contractors.

In connection with the erection of the new Union Station, the contract for stone work has been awarded to George Oakley & Son, 278 Booth Avenue, at about $350,000.

The contract for heating and plumbing required in the erection of a business block at Bloor and North Streets for F. Nicholls, has been let to G. R. Baker, 37 Lappin Avenue.

The contract for masonry required in the erection of a block of stores and apartments on Bathurst Street for W. Argue, 235 Broadview Avenue, has been awarded to William Gleed, 91 Dingwall Avenue, and the carpentry to F. Moore, 80 Soudan Avenue. Estimated cost, $6,000.

Vancouver, B.C.
The Department of Public Works, Ottawa, have awarded the general contract for the erection of a freight shed on the Government Wharf to Snider Brothers, 500 Beatty Street, Vancouver, at $44,994. Construction of British Columbia fir.

Residences

Carlingford, Ont.
R. S. Smith is building a residence, estimated to cost $3,000. White brick and concrete construction.

Chatham, Ont.
W. H. Asher, Hilliard Street, is about to erect four residences, estimated to cost $2,500 each. Frame and concrete construction.

Exeter, Ont.
Harvey Brothers are having plans prepared for a residence which they propose to build on North Street. Estimated cost, $3,000.

Hamilton, Ont.
T. R. Hawkins, 60 Barnsdale Avenue S., proposes to build a residence on Leinster Avenue at an approximate cost of $3,500, and has had plans prepared. Brick and concrete construction.

Work has been started by J. W. Gathercole, 439 King Street W., on the erection of three residences on Simcoe Street E. Estimated cost, $3,600. Brick and concrete construction.

T. A. Wooley, 18 John Street West, is considering the erection of three residences at an approximate cost of $6,000. Brick and concrete construction.

Listowel, Ont.
Robert Oliver is about to start work on the erection of a residence, estimated to cost $5,000. White brick construction.

Malden Township, Ont.
John Waters, Amherstburg, Ont., will shortly commence the erection of a residence. Frame and white brick construction. Approximate cost, $3,000.

Montreal, Que.
D. Riendeau, 57 Mentana Street, has commenced work on alterations to three flats, estimated to cost $3,000. Brick and concrete construction.

Work by day labor is about to start on the erection of five residences for A. Hoolahan, 367 Drolet Street, estimated to cost $3,000. Brick and concrete construction.

C. Lewis, 118 Grand Boulevard, is about to commence the erection of a block of flats, estimated to cost $20,000. Brick and concrete construction.

Laflamme & Bedford, 3137 St. James Street, have commenced the erection of two residences, estimated to cost $4,500 each, and are receiving tenders on roofing, heating and plumbing.

L. A. Gagnier, 256 St. Denis Street, is about to start work on alterations to a residence, estimated to cost $6,000.

Ottawa, Ont.
B. A. Grison, 83 Bank Street, has commenced the erection of a residence on Fentiman Avenue, and will let the smaller trades. Brick, stucco and concrete construction. Approximate cost, $5,000.

B. A. Grison, 21 Fentiman Avenue, is about to start work on a residence, estimated to cost $3,000. Brick, concrete and stucco construction.

D. Vachon, 40 Stirling Avenue, has commenced the erection of a residence on Fairmont Street, estimated to cost $3,500. Brick veneer and concrete construction.

John Clyne, 77 Cobourg Avenue, is about to start work on a residence on Clarence Street, estimated to cost $3,000. Brick veneer and concrete construction.

Paisley, Ont.
J. S. Dewar proposes to build a residence at an approximate cost of $3,000, and is having plans prepared. Brick and concrete construction.

Quebec, Que.
J. Lafond, 284 St. Francois Street, has commenced the erection of a residence, estimated to cost $7,000. Brick and concrete construction.

Work has been started by P. Gingras, 29 Parent Avenue, on the erection of a residence, estimated to cost $5,000. Brick and frame construction.

J. Cauchon, 364 Richelieu Street, has started work on a residence on Stigmates Street, estimated to cost $8,000. Smaller trades will be let. Brick construction.

E. Beaudoin, 256 Prince Edward St., is about to start work on the erection of a residence, estimated to cost $6,000. Smaller trades will be let.

Work on the erection of a residence has been started by A. Guilmette, 125 Church Street. Frame and brick construction. Approximate cost, $4,000.

A. Amyot, 212 Third Avenue, has commenced the erection of a residence, estimated to cost $4,000. Frame and brick construction.

A. Couture, 1122 St. Valier Street, is building a residence on St. Raphael St., estimated to cost $6,000.

Thamesford, Ont.
Plans of a residence are being prepared by George Hamilton. Brick and concrete construction. Estimated cost, $3,500.

Toronto, Ont.
W. G. Hunt, Architect, 12 Queen St. E., is receiving tenders until May 13th for the erection of a residence at Munro Park, estimated to cost $4,000. Brick construction.

Devers Brothers, 51 Bird Avenue, have had plans prepared for a residence to be built at 67 Lauder Avenue, and will let smaller trades. Brick and stone construction. Approximate cost, $3,800.

T. W. Robinson, 11 Evelyn Crescent, has commenced the erection of a residence, and will let smaller trades. Brick construction. Estimated cost, $3,500.

Work has been started by W. H. Moore, 79 Bellefair Avenue, on the erection of a residence and garage at 260 Waverley Road. Brick construction. Estimated cost, $3,000. Smaller trades will be let.

Plans have been prepared for a residence to be built by W. Walker, 91 Rosehill Avenue. Brick construction. Approximate cost, $3,800. Smaller trades will be let.

T. Bailey, 79 McKay Avenue, has commenced the erection of a residence, estimated to cost $5,000, and will let smaller trades. Stone and concrete block construction.

J. Stone, 49 Coleman Avenue, is receiving tenders on all trades except brick work required in the erection of four residences. Estimated cost, $5,000.

Work has been started by J. A. Shier, 61 Standish Avenue, on the erection of a pair of residences, estimated to cost $3,500. Smaller trades will be let. Granite concrete block construction.

C. A. Drew, 119 Nairn Avenue, is receiving tenders on all trades except carpentry required in the erection of a residence on Lauder Avenue, York Township, for F. H. Miller. Estimated cost, $3,000.

A. W. Betson & Terry, 3 Fenwick St., have commenced the erection of a pair of residences on Greenwood Avenue, estimated to cost $3,800. Brick construction.

C. A. Jones, 69 Fairview Avenue, proposes to build a residence on Woodside Avenue, at an approximate cost, of $4,200, and has had plans prepared. Smaller trades will be let.

R. J. Cole, 11 Northcliffe Boulevard, is about to start work on the erection of seven residences, estimated to cost $15,000. Smaller trades will be let. Brick and stone construction.

Gagnon & Cairns, 2359 Queen Street E., propose to build a residence at an approximate cost of $3,000, and have had plans drawn. Smaller trades will be let. Brick construction.

A. F. Foster, 493 Rushton Road, has commenced the erection of a residence, estimated to cost $3,500. Smaller trades will be let. Brick construction.

F. Warner, care of 221 Howard Park Avenue, is receiving tenders on all trades required in the erection of a residence, estimated to cost $3,000. Brick construction.

B. J. Case, 34 Nina Avenue, has commenced the erection of a residence on Glenholme Avenue, estimated to cost $3,000. Granite concrete block and brick construction.

E. T. Miller, 384 Lauder Avenue, proposes to build a pair of residences at an approximate cost of $4,000, and has had plans prepared. Brick construction.

A. & A. Grant, 837 Logan Avenue, have commenced the erection of a residence, estimated to cost $3,000, and will let smaller trades. Brick construction.

Westmount, Que.
Charles Fyfe, 176 Mance Street, Montreal, has commenced the erection of two residences, estimated to cost $9,000.

Windsor, Ont.
G. Jacques & Company, Architects, Boug Block, will receive tenders until May 15th for the erection of a duplex residence on Dougal Street for Percy England, Tecumseh Road. Brick and stucco construction. Approximate cost, $7,500.

G. Jacques & Company, Architects, Boug Block, are preparing plans of a residence for V. Beausoliel, Victoria Road, Walkerville. Brick veneer and concrete construction. Approximate cost, $4,500. Work by day labor.

Zurich, Ont.
R. W. Hess is considering the erection of a residence. Estimated cost, $3,500.

CONTRACTS AWARDED

Aldershot, Ont.
The contract for plastering required in the erection of a residence for F. W. Easerbrook has been awarded to Watson Brothers, 138 Argue Street, and the heating and plumbing to Dickenson & Allen, Emerald Street N.

(Continued on page 47)

Tenders and For Sale Department

TENDERS

For the Construction of an Extension to St. Clair Avenue Car Barn

Tenders will be received through registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to noon on **Tuesday, May 23rd, 1916**, for the complete construction of a steel frame, brick faced tile addition, including heating plant, to the St. Clair Avenue Car Barn, Christie Street.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application at Room No. 311, Department of Works, City Hall, on payment of ten dollars ($10.00), this sum to be refunded upon return of plans.

Tenderers must comply strictly with conditions of City By-law as to deposits and sureties as set out in specifications and forms of tender.

The lowest or any tender not necessarily accepted.

T. L. CHURCH, (Mayor),
Chairman, Board of Control.

19-19

Tenders for Street Car

Tenders will be received by registered post only, addressed to the Chairman Board of Control, City Hall, Toronto, up to 12 o'clock noon, on Tuesday, May 23rd, 1916, for the supply and delivery of:—

	Tender Number
One Single Truck, Double End, Street Car, completely equipped, ready for operation, for Bloor Street Division, Toronto Civic Railway	37
One Car Body, Double End, Single Truck, for Bloor Street Division, Toronto Civic Railway	37-A
Equipment for One Single Truck Car, for Bloor Street Division, Toronto Civic Railway, Electrical Equipment	37-B
Equipment for One Single Truck Car, for Bloor Street Division, Toronto Civic Railway, Single Truck	37-C

Envelopes containing tenders must be plainly marked on the outside as to contents. Specificationh and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, (Mayor),
Chairman Board of Control.

19-19

FOR SALE STEAM ROLLERS

One single cylinder Sawyer Massey 13 tons; one double cylinder Waterous, 15 tons. Both in perfect condition. Apply to Box 196, Three Rivers, Que. 19-20

Concrete Sidewalks

Tenders for Concrete Sidewalks for Markham Village, approximately 35,000 sq. feet, Toronto city specifications, will be received by undersigned up to **May 15.** Lowest or any tender not necessarily accepted. Apply to

M. WHITE,
Clerk Corporation Markham.

19-19

Canadian Pacific Railway Co.

North Toronto Grade Separation

Tenders will be received by the undersigned up to May 31st, 1916, for the purchase and removal of the old Canadian Pacific Railway North Toronto Station Building.

Proposal forms and other information may be obtained at the office of the undersigned, 262 Avenue road, Toronto.

No tender necessarily acceptee.

B. RIPLEY,
Engineer of Grade Separation.

19-19

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

AGENTS WANTED

Canadian sales agents wanted for best line of excavating outfits made in the United States. Apply Box 393 "Contract Record & Engineering Review," Toronto, Ont. 17-19

Late News Items

L'Islet, Que.
The store and residence owned by Albert Dionne have been destroyed by fire. Loss, about $12,000. Owner will probably rebuild.

Montreal, Que.
The general contract for the erection of a block of stores and residences for Mrs. P. Bourdon, 478 Demontigny St., has been awarded to T. Bellehumeur, 1420 Messier Street, and the concrete work to O. Laquerre, 1723 Des Erables Street. Carpentry and interior work by day labor. Approximate cost, $10,000.

Ottawa, Ont.
In connection with the plant now being constructed by the Burrows Refining Company, 629 Wellington Street, the contract for tanks and machinery has been let to the Campbell Steel & Iron Works, Carling Avenue, Ottawa, at $30,000.

Peterborough, Ont.
The general contract for the erection of a church for St. James Methodist Congregation has been awarded to H. Fry, 190 Rubridge Street. Tenders will be called shortly for sub-contracts. Approximate cost, $25,000.

St. Hilaire de Dorset, Que.
The general contract for the erection of a church for the Roman Catholic Congregation has been awarded to A. Gagnon & Fils, Lambton, Que. Estimated cost, $14,000.

Timmins, Ont.
The Hollinger Gold Mines, Limited, are building an addition to their mill, estimated to cost $750,000, and will require large quantities of concrete and mining machinery and steel.

Toronto, Ont.
The Martin Pump & Machine Company, Limited, 43 Davies Avenue, propose to start work shortly on the erection of a factory at Wilton and Broadview Avenues, estimated to cost $10,000. Brick construction.

The Board of Control have transferred the following contracts:—paving on Clendennan Avenue to Warren Bituminous Paving Company of Ontario, Ltd., McKinnon Building, at $18,797; concrete work on Strachan Avenue Bridge to C. J. Townsend, 79 Spadina Avenue, at $25,255.

The following contracts have been let for the erection of a residence and garage at 425 Broadview Avenue for G. Heffering:—masonry and carpentry, J. H. Champion, 720 Logan Avenue; plumbing, W. Wray, 162 Delaware Avenue; heating, W. Schulkins, 932 College St.; plastering, Hanna & Nelson, 273 Rusholme Road; roofing, George Sinclair, 307 Clinton Street; wiring, M. Nealon, 15 Harbord Street; tile work, Italian Marble & Mosaic Company, College Street. Approximate cost, $9,000.

West St. John, N.B.
Tenders on the construction of a retaining wall and backfilling will be received until 4 p.m., May 22nd, by R. C. Desrochers, Department of Public Works, Ottawa. Plans and specifications at offices of the District Engineer, Halifax, N.S. and St. John, Shaughnessy Building, Montreal, and at the Department. Specifications only at office of MacLean Daily Reports, Limited, 25 Charlotte Street, Toronto.

Westmount, Que.
The following contracts have been awarded in connection with the erection of a residence on Kitchener Avenue for the Catholic Commissioners of St. Leo:—masonry, A. Charette, 1221 St. Antoine Street; carpentry, R. Laberge, 141 Convent Street; brick work, C. Morin, 1792 Christophe Colomb Street; heating and plumbing, Ducharme Blais & Company, 1995 St. James Street.

Weston, Ont.
W. H. Bell, Hillcrest Road, is about to build a two-storey brick residence, cost $3,000.

Residences

(Continued from page 45)

Amherstburg, Ont.
The following contracts have been let for the erection of a residence for D. Laferte, 352 Jefferson Avenue E., Detroit, Mich.:—masonry and plastering, J. B. Wilson, Amherstburg; carpentry, W. Dupuis, 147 Dougal Avenue, Windsor; painting, Lossing & Harris, 100 Church Street, Windsor; plumbing, Ryan & Company, Amherstburg; electrical work, G. Campeau, 121 Tuscarora Street, Windsor. Approximate cost, $5,000.

Brantford, Ont.
The general contract, masonry, carpentry, roofing, plastering and painting for the erection of a residence for E. L. Goold, 103 Darling Street, have been awarded to Schultz Brothers & Company, Limited, 47 Albion Street, and the heating and plumbing to Anguish & Whitfield, 40 Colborne Street. Estimated cost, $11,000.

Charlottetown, P.E.I.
In connection with the residence being built for A. E. Duff, 26 Great George Street, the contract for heating has been let to James McEachern, 34 Upper Millen Street, painting to Stanley, Shaw & Peardon, Great George Street, and electrical work to W. P. Doull, 105 Kent St.

Chicoutimi, Que.
The general contract for the erection of a residence for Charles Duperre has been awarded to Adelard Robin. Approximate cost, $7,500.

Cornwall, Ont.
Henry Williams has awarded the contract for steel work in connection with the residence which he is about to build on Pitt Street to the Phoenix Bridge & Iron Works, Limited, 83 Colborne St., Montreal.

Georgetown, P.E.I.
The contract for the erection of a residence for John Stewart has been let to Peter Bradley, Kelly's Cross, P.E.I. Frame and concrete construction. Approximate cost, $4,000.

Hamilton, Ont.
The general contract, masonry, carpentry, roofing, heating and plumbing for the erection of a residence for E. A. Demipster, City Accountant, have been awarded to T. D. Barnes, 90 Jackson Street. Approximate cost, $4,000.

In connection with the residence in course of erection for E. A. Mark, 8 John Street N., the contract for plastering, painting, heating, plumbing and electrical work has been let to H. Barnes, 212 Balsam Avenue.

In connection with the alterations now being made to a residence for W. J. Whitfield, 224 Main Street E., the contract for heating and plumbing has been let to J. N. Luxon, 60 Leeming Street, and the plastering and painting to the general contractor.

Montreal, Que.
The general contract for the erection of a block of flats for E. Desmarais, 2969 St. Denis Street, has been let to Xavier Charbonneau, 1813 Clarke Street. Brick and stone construction. Approximate cost, $15,000.

The general contract for the erection of a residence for B. Bonnier, 1639 St. Catherine Street E., has been let to J. A. Durocher, 291 Chambly Street. Approximate cost, $10,000. Brick and stone construction.

A. A. Collett, 117 Fifth Avenue, Maisonneuve, has commenced work on alterations to the residence of N. Lemieux, 151 St. Joseph Boulevard. Approximate cost, $3,500.

Niagara Falls, Ont.
The general contract for the erection of a residence for J. S. Baxter, Niagara Falls South, has been let to Zimmerman Brothers, 23 McRae Street. Estimated cost, $3,000.

Oshawa, Ont.
The general contract for the erection of a residence for Robert Jacobs has been awarded to Gay & Company. Brick veneer construction. Approximate cost, $3,200.

The general contract for the erection of a residence for N. F. Mechin has been let to John M. Richards. Brick veneer construction. Estimated cost, $3,000.

Outremont, Que.
James Marquis, 2655 Esplanade Avenue, has commenced the erection of a residence for A. E. Fraser, 1237 Van Horne Street. Brick and stone construction. Approximate cost, $8,000.

Quebec, Que.
The contract for roofing, heating, plumbing and electrical work required in connection with the residence now being built by Leon Nadeau, 105 Franklin Street, has been let to J. Lafrance, 21 Plessis Street.

The contract for plastering and masonry required in the erection of a residence for H. M. Cote, 631 St. John St., has been let to Poulin & Marcoux, 144 Latourelle Street. Smaller trades will be sub-let by the general contractor.

In connection with the residence being built by J. Lafrance, 21 Plessis St., the masonry has been let to A. Fackney, 107 St. Joachim Street, and carpentry to Leon Nadeau, 105 Franklin Street. Painting and plastering will be sub-let.

The contract for masonry required in the erection of a residence for J. Verret, 190 Third Avenue, has been awarded to J. B. Verret & Fils, 184 Third Avenue. Brick, stone and concrete construction. Estimated cost, $10,000.

The general contract for the erection of a residence for H. P. Couillard, 17 Dollard Street, has been awarded to Latulippe & Gosselin, 118 Bagot Street, and work started. Brick and concrete construction. Estimated cost, $4,000.

Work has been started on the erection of a residence for F. D. Pare, 205 Third Avenue. The carpentry has been let to G. Pare, 7 Lalibeter Street. Approximate cost, $7,000.

Sarnia, Ont.
The general contract for the erection of a residence for T. V. Anderson, 165½ Front Street N., has been let to A. McColman 120 Mitton Street. Brick and concrete construction. Approximate cost, $5,000.

Tara, Ont.
The general contract for the erection of a residence for William Munson has been let to W. P. Evans, 654 Eighth St E., Owen Sound. Brick and concrete construction. Estimated cost, $3,000.

W. P. Evans, 654 Eighth Street E., Owen Sound, has been awarded the contract for the erection of a residence for T. McLelland. White brick and concrete construction. Approximate cost, $3,000.

Toronto, Ont.
The following contracts have been awarded for the erection of a residence on Ridous Street for F. Gilmour, care of Ellis & Ellis, Manning Chambers:—masonry and plastering, George Davenport, 51 Helena Avenue; carpentry, Smith & McElroy, 208 Close Avenue; plumbing and heating, R. Paterson, 907 Keele St.; tile work, Italian Mosaic & Tile Company, Manning Chambers. Approximate cost, $8,000.

D. Muir, 223 Osler Avenue, has let the general contract for the erection of a residence to Kerr & Martin, 47 Gilmour Avenue. Smaller trades will be sub-let. Approximate cost, $4,500. Brick construction.

The contract for heating and plumbing required in the erection of a residence for Mrs. O. G. Palm, 133 Roxboro Street E., has been let to Fiddes & Hogarth, 122 King Street E., painting to J. G. McConkey, 83 Westminster Avenue, slate roofing and sheet metal work to R. Rennie & Son, 198 Dupont Street, and electrical work to W. H. Lodge, Bain Avenue.

Watten, Ont.
Frank P. Wilson, R. R. No. 2, Tupperville, has let the contract for the erection of a residence to E. Graham. Approximate cost, $3,000. Frame, brick and concrete construction.

Westboro, Ont.
F. Dean, Henry Street, has started work on a residence, estimated to cost $3,000, and has been awarded the electrical work to J. Frost, Henry Street. Brick veneer and concrete construction.

T. Dagger, Royal Avenue, Ottawa W., is building a residence, and has let the electrical work to J. Frost, Westboro. Brick veneer and concrete construction. Approximate cost, $4,000.

F. Smith, Riverside Park, has let the electrical work in connection with the residence which he is building to W. D. Jeffrey, Second Avenue, Woodrooffe, Ont. Brick veneer and concrete construction. Estimated cost, $3,000.

Windsor, Ont.
J. C. May, 199 Dougal Avenue, is building a four-family flat for G. B. Scott, 51 Louis Avenue. Brick and concrete construction. Approximate cost, $7,000.

S. C. Robinson, Devonshire Road, Walkerville, has let the general contract for the erection of ten residences of various sizes to R. Wescott, 55 Oak Avenue. Frame, stone and concrete construction.

The contract for carpentry required in connection with the residence now being built for J. C. Pennington, La Belle Building, has been awarded to the general contractor, and heating and plumbing to Pennington & Brian, 47 Sandwich Street W.

The general contract, masonry, carpentry, steel work, roofing, plastering and painting required in the erection of a four family flat for Mrs. R. Hamer, 47 Louis Avenue, have been let to J. C. May, 199 Dougal Avenue, the plumbing to George Smith, 153 Wyandotte Street E., and the electrical work to F. E. Garfat, Glengary Avenue. Approximate cost, $6,000.

William Hedrick, 6 Glengary Street, is building a residence for James Wilkins, 165 Sandwich Street E. Brick veneer and concrete construction. Estimated cost, $3,500.

Yorkton, Sask.
Plans have been prepared by D. S. Sedgwick, 1135 Lumber Exchange, Minneapolis, Minn., for a residence to be built on Third Avenue for A. O. Whitman, and the contract for construction of basement has been let to W. Peterson. Frame and brick construction. Approximate cost, $4,000.

Power Plants, Electricity and Telephones

Galt, Ont.
The by-law to authorize the installation of a fire alarm system and the purchase of equapment has been defeated.

Rodney, Ont. ... ...
A by-law has been carried authorizing the construction of a hydro electric system, at an approximate cost of $7,000. Town Clerk, S. B. Morris.

Saskatchewan Province
The following Rural Telephone Companies have been authorized to borrow money for the construction of their system:—Banner Rural Telephone Company, $10,000, Secretary, R. Brown, Kipling; Speers, $14,000, S. Chivers Wilson, Speers; Pelican, $10,000, G. A. Haist, Mortlach; Balgonie, $12,000, C. C. Rigby, Balgonie; School, $6,700, J. G. Brown, Scott; Cullen, $4,000, C. C. Davison, Cullen; Landshut, $4,000, John Betz, Jr., Langenburg.

St. Foye, Que.
The Municipal Council are considering the installation of an electric lighting system, estimated to cost $15,000. Secretary, P. N. Robitaille.

Stratford, Ont.
The Town Council are considering extensions and improvements to the electrical system, estimated to cost $33,000. Clerk, R. R. Lang.

Wyoming, Ont.
A by-law has been carried authorizing the installation of a hydro system, at an approximate cost of $6,500. Town Clerk, H. G. Taylor.

Fires

Bentley, Alta.
Business block owned by J. G. Bliss. Loss, $15,000.

Effingham, Ont.
Residence and barn owned by Peter Ward. Loss, $5,000. Owner may rebuild.

Gourock, Ont.
Store and Post Office owned by Alexander Ireland. Loss, $3,500. Owner contemplates rebuilding.

Levis, Que.
Store and residence of G. E. Couture. Loss, $25,000. Will be rebuilt.
Residence owned by T. Bissonnette, 129 Cote du Passage. Loss, $5,000.

Maisonneuve, Que.
Residence owned by Walter Reed, 135 De Beaujeu Street. Loss, $3,000. Repairs will be made.

Tenement buildings owned by Reed & Gratton. Loss, $26,000. Will be rebuilt.

Medicine Hat, Alta.
Milling plant of the Lake of the Woods Milling Company. Loss estimated at $500,000.

Okanagan Falls, B.C.
Post Office owned by the Department of Public Works, Ottawa. Loss, $4,000.

Orillia, Ont.
Skating rink, owned by F. A. Doolittle. Loss, $10,000.

Owen Sound, Ont.
Plant of the Union Cement Works Company damaged. Loss, $4,000.

Pennfield, N.B.
Residence and barn owned by Charles Gillespie. Loss, $5,500.

St. Boniface, Man.
Mills of the Rice Malting Company of Canada. Loss, $300,000.

St. Catharines, Ont.
Business owner by the Dominion Bank of Canada. Loss, $20,000.

Verdun, Que.
Residence owned by T. Lanquette, 317 Gertrude Street. Loss, $5,000. Repairs by day labor.

Winnipeg, Man.
Printing and engraving plant of the Stovel Company. Loss estimated at $500,000.

Miscellaneous

Chatham, Ont.
The Union Natural Gas Company, Chatham, propose to relay a 10-inch high pressure gas main from the wells at Port Alma to Sombra, a distance of forty miles. Approximate cost, $300,000.

Frontenac County, Ont.
Tenders on the erection of a wooden lighthouse and dwelling at Burnt Island will be received until noon, May 17th, by the Deputy Minister of Marine, Ottawa. Plans and specifications at the Department, the Department Agency, Prescott, and the Post Offices at Brockville, Gananoque, Belleville and Kingston.

North Bay, Ont.
The City Engineer, H. J. McAuslan, will receive tenders until noon, May 15th, for the supply of about 3,000 feet of 6-inch and 630 feet of 4-inch cast iron watermain and specials.

Ottawa, Ont.
The Ottawa Improvement Commission, 110 Wellington Street, are having plans prepared for lavatories to be built in Rockliffe Park, at an approximate cost of $10,000. Brick and concrete construction.

Sault Ste. Marie, Ont.
The Algoma Steel Corporation are in the market for quantities of brick.

CONTRACTS AWARDED

Westmount, Que.
The City Council have awarded the following contracts for supplies:—cement, Webster & Sons, Ltd., 31 Wellington Street, Montreal; cement and vitrified sewer pipe, tile and inverts, W. & F. P. Currie & Company, 345 St. James Street, Montreal; brick, Laprairie Brick Company, Victoria Square, Montreal, and St. Lawrence Brick Company, 71 St. James Street, Montreal; vitrified sewer pipe, Hamilton & Toronto Sewer Pipe Company, Dominion Bank Building, Toronto.

ESTABLISHED 1886

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Vol. 30 **May 17, 1916** **No. 20**

Principal Contents

Recruiting from Munition Factories

A large Canadian manufacturer engaged in completing, with feverish haste, a big munitions contract, stated within the last couple of days that pressure had again been brought to bear on one of his best mechanics to drop his work and join the fighting ranks. In spite of all the arguments of the employer the man had gone. This is only one instance of many we know of and doubtless of many hundreds that have not come to our attention.

How much longer can our government sit inanely by and watch this gradual process of demoralization and disintegration without taking any steps to prevent or remedy it? If our government is so lacking in the type of men who have the ability to conceive and carry out the necessary organization of our man power, or if they are so held in by the traditional curse of political exigency, can they not at least hand the matter over to some responsible group of business men? Such men, organizers both by training and natural ability, to be had in numbers for the asking, who would consider it a disgrace to accept salary or commission, who would honor themselves by being allowed to express their deep loyalty in placing their services at the disposal of the Empire—many of these superb business men in Canada to-day are chafing at their inability to assist in this war and impatiently cursing our government for their inactivity and all too apparent helplessness in grappling with some of our big problems. Why don't we organize? is heard in every quarter. Are our resources so much more than adequate for the demands to be made upon them that we can afford to fritter them away?

It is an old saying that constant dropping water will wear away even a stone, and it is not impossible that constant urging and dinning, in these pages, may yet play some small part in arousing our government to action along the line of organizing our men power and our other big resources that the greatest amount of work may be accomplished with the least possible expenditure of energy. It's a business man's job, of course, but business men by the score are vainly offering their services. Will not the authorities at Ottawa admit, soon, that the conduct of the details of a great war is not in their line and pass the work along to others who are as capable as they are eager to undertake it?

The Cause and Prevention of Dry Rot

From time to time inquiries are received at this office asking for information on the cause and prevention of dry rot in mill construction. The Contract Record has published occasional short items on this subject, but in the hope that it may be of assistance and to more fully explain the matter a fairly comprehensive article on dry rot appears elsewhere in this issue.

Rotten timber is due to decomposition brought about by dampness, which generally proceeds by the emission of carbonic acid gas and hydrogen. Timber rot may be either wet or dry; the former usually occurs in the presence of moisture where gases emitted may escape. Dry rot, on the other hand, is found in confined places where the gases which are emitted cannot escape but enter into some new combination aiding in the formation of fungi, a parasitic vegetable growth which feeds upon and destroys the timber. This fungus growth is commonly termed as punk, toadstools, or dry rot—terms which are exceeding vague and indefinite.

The term, dry rot, is used to signify broadly the following fungi: Merulius lachrymans and other members of the Merulius genus; Coniophora cerebella (or Coniophora peuteana). These dry rot fungi have two methods of reproduction—by the common reproductive body corresponding to the seeds of the higher plants, which is called a spore, a microscopic organism brown in color, which is produced in millions on the surface of the plant; or by the growing plant separating into small sections which grow again under suitable conditions.

Dry rot is usually caused by moisture and the lack of ventilation, or exposure to alternate wet and dry spells, and the use of green sap wood. It is dangerous, as is known, in that it reduces the cohesion of the wood fibre, ultimately reducing it to powder. Dry rot is best prevented by using seasoned heart wood and providing good ventilation, or by treating it with some wood preservative such as creosote. After the growth is started it may, if not too far advanced, be checked by heat and ventilation. Merulius lachrymans is particularly sensitive to heat, a temperature of 108 degs. F. for three hours or 115 degs. F. for one hour being sufficient to kill it. It is also killed by complete dryness. Antiseptic treatment is practically the only procedure to adopt for lumber of doubtful durability or for lumber that is to be placed in a position suitable for the generation of dry rot, or for wood previously exposed to dry rot. Much valuable information on dry rot, conditions suitable to its growth, means of prevention, etc., will be found in the article mentioned above, which should prove of value to owners or builders who have met with this trouble.

What is a Pavement?

What types of roadway surfacings should properly be classified as pavements?

This query has been suggested recently by an examination of data on street paving in a number of cities. The figures referred to included statements showing the total mileage of paved streets and the mileage of each type of surfacing in each of a number of cities. Some street officials classed streets surfaced with gravel and water-bound macadam as paved streets, while others excluded these two surfacings and, in a few cases, others.

The dictionary definition of a pavement is: "That with which anything is paved; a floor or covering of solid material, making a hard and convenient surface for travel; a paved road, sidewalk, or other surface." The verb, pave, is defined as follows: "To lay or cover with stone, brick, or other material, so as to make a firm, level, or convenient surface for travel; to floor with brick, stone, or other solid material; to cover as a pavement." These definitions are sufficiently broad to permit the inclusion of gravel, water-bound macadam, sand-clay, and various other surfacings as pavements.

On the other hand, the American Society of Civil Engineers' Special Committee on Materials for Road Construction and on Standards for their Test and Use has defined a pavement as follows: "The wearing course of the roadway or footway, when constructed with a cement or bituminous binder, or composed of blocks or slabs, together with an cushion or binder course." Under this definition gravel, water-bound macadam and some other types of surfacings would not be pavements.

While the dictionary definition and the one proposed by the committee are not comparable, they reprecent exactly the difference of opinion that apparently exists among street officials and engineers. Doubtless the committee's definition merits the greater consideration, for it was made by experts, while the dictionary definition was not. Certainly it seems to represent the current usage of engineers and technical writers.

Although the question is perhaps of minor importance, it is worthy of consideration, for the subject of road building terminology needs standardization.—Good Roads.

Hints on Sewer Construction

Mr. W. W. Horner, engineer in charge of division sewers and paving, St. Louis, Mo., in addressing the 12th annual convention of The American Concrete Institute at Chicago on reinforced concrete in sewer construction, recommends to engineers and contractors the following prescription for sewer construction:—

(1) Use the best grade of concrete and considerable excess of mortar. (2) Do not work concrete at more than 450 lb., unless the construction conditions are to be exceptionally favorable. (3) The concrete cover outside of the steel should be at least 2 in. (4) Use a minimum thickness of concrete of about 9 in., unless the work is close to the surface, or is to be built under very favorable conditions, and increase this minimum and also the cover over the steel if the conditions are likely to be very unfavorable. (5) Specify the setting of the reinforcement with especially designed holders. These might be made of cast iron and left in the concrete. (6) If there is any possibility that the trench will be very wet or mucky, provide for a sub-case of concrete and provide means of keeping the trench work away from the work, if possible. (7) To secure a concrete that will flow into place with the least assistance, a specification for a two-and-a-half or a three minute mix should be seriously considered, as might also the use of hydrated lime. This would naturally result also in a denser and more waterproof concrete and might be a very considerable factor in prolonging the life of the reinforcement. (8) Provide for a lining of vitrified brick for the invert, or at least provide an excess internal area to allow for such a lining at some later date. This is of more importance in maintenance than in construction, as under average conditions it is easier to obtain a reasonably smooth invert with the brick than to attempt to finish the concrete itself. (9) Specify cold weather methods. Concrete can be placed satisfactorily and economically at even a zero temperature, if proper precautions are taken. It should be noted, however, that it is quite easy to overheat the finished concrete and to drive out a portion of the water.

A Union Station for Montreal

The Montreal Central Terminal Company is reviving an old and ambitious scheme for a Union station. Mr. C. N. Armstrong has placed before the Council the outline of the plan, which includes the construction of a tunnel under the St. Lawrence, thus connecting the north and south shores. The station is to be built in a central portion of the city, and is estimated to cost about 35 million dollars. It would give accomodation for all the lines entering the city, connection being made with the Windsor Station of the C. P. R. The Bonaventure Station of the Grand Trunk would be converted into a freight depot. Such a scheme would settle the question of level crossings, which has been several times before the Railway Commission in connection with the obligation of the city to bear a portion of the raising of the tracks of the Grand Trunk. The proposal is that all the lines running into the union station should be electrified. The promoters state that application is to be made to the Railway Commission and that the capital will be privately subscribed.

Dry Rot Menace in Factory Timbers

Conditions Favorable to the Growth of Common Timber-Destroying Fungi—Discussion of Methods of Preventing Their Development

All wood is almost equally durable under certain conditions. Kept absolutely dry or submerged it lasts indefinitely, but under other conditions the best wood may decay very rapidly. Dryness and good ventilation are the best guarantees of prevention from decay in timber used in general construction. Water also seems to act as a preservative, as some kinds of timber totally and constantly submerged in water not in motion, have been found to remain practically sound for hundreds of years.

The general causes of decay in timber are the presence of sap, exposure to alternate wet and dryness, or to moisture accompanied by heat and lack of ventilation. Rotten timber is due to decomposition or putrefaction, generally occasioned by dampness, and which proceeds by the emission of gases, chiefly carbonic acid gas and hydrogen. There are two kinds of rot to which wood work in a building is subject, dry rot and wet rot. The chief difference between them seems to be that wet rot occurs where the gases involved can escape. By it the tissues of the wood, especially the sappy portions are decomposed. Dry rot, on the contrary, occurs in confined places where the gases cannot escape, but enter into new combinations, forming fungi, which feed upon and destroy the timber.

Dry rot is generally caused by lack of ventilation; confined air, without much moisture, encourages the growth of the fungus, which eats into the timber, renders it brittle and so reduces the cohesion of the fibres that they are reduced to powder. It generally commences in the sapwood.

Dry rot is especially dangerous in that it not only eats up the entire timber in which it originates, but the germs of the fungi producing it spread themselves to all adjacent woodwork without necessary contact between the diseased and the sound wood.

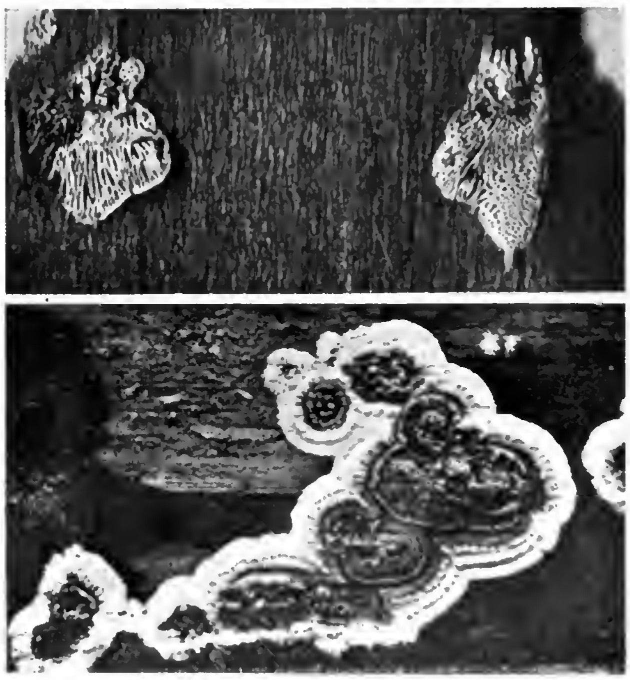
There are but few common or popular names for fungi, and the few there are, such as dry rot, punk, toadstools, etc., are exceedingly vague and indefinite. The Latin names are commonly used in scientific literature. Their use implies an exact identification. "Dry rot" is used to signify broadly the following fungi: Merulius lachrymans and other members of the Merulius genus; Coniophora cerebella (or Conicophora puteana). The name "Polyporus family" (fungi having many pores) has been used to include broadly any of the pore fungi having pores or holes of various sizes and shapes in the fruiting surface. Fruiting fungi can be easily identified but it is impossible to positively identify the young sterile growth.

The conditions required for the germination or growth of the merulius lachrymans have often seemed mysterious. The spores germinate in an eccentric manand frequently refuse to grow to fruition on their customary host in artificial cultures. Dry rot fungi have two methods of reproduction and can remain a long time in a resting state. The common reproductive body, corresponding to the seed of higher plants, is called a spore, and grows over the surface of the plant. Spores are brown in color and therefore may be easily distinguished from the surrounding sterile growth. They are microscopic in size, being about .0004 of an inch long and .0002 of an inch broad. A single plant produces many millions and their small size allows them to float a long distance in the air.

Under unfavorable conditions for growth, such as insufficient moisture, some of these destructive fungi assume a form of reproduction different from that by which they ordinarily spread. In this form, the growing plant separates into small sections which can sprout and grow again when favorable conditions arise. It can remain in this resting state for a considerable time in air dry wood.

Rot in wood was originally supposed to be a chemical action similar to rusting of iron, and the delicate lace-like plants, tough brackets, or brown leathery growths were supposed to be attracted by the decayed wood, rather than being the cause of the rotting. The chemistry of the rotting process is not well known even at the present time. It is probable that there is some chemical action in addition to the life progress of the fungus through the wood cells. It is noted in blocks of sound wood, in which fungus has been cultivated, that when the fungus is freshly removed from the moist wood, it has the appearance of being bright and sound as ever; but, after being left in a dry atmosphere for a time, the wood shrinks and forms the characteristic brown, cracked and powdery material which is familiar as rotted wood.

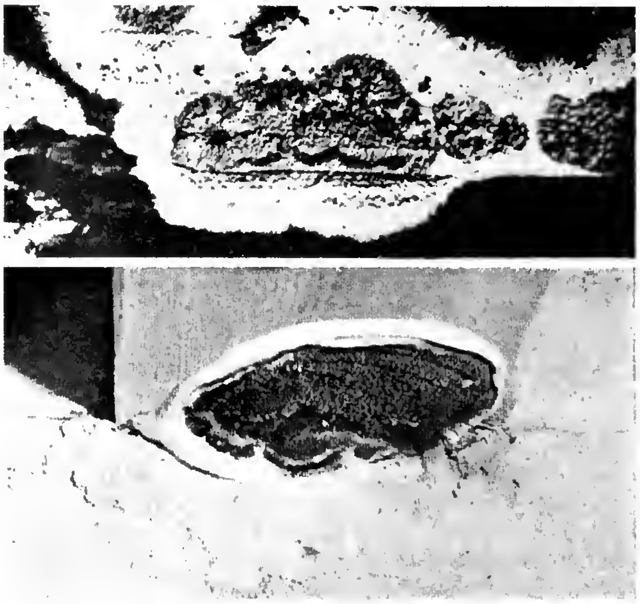
Without doubt, the fungus ceases to make any vital progress very soon after drying commences, and the final browning and powdering is brought about by oxidation by the air, assisted by certain organic enzymes, either already present in the wood cells or formed by the activity of the fungus.



Types of fungi—Upper, Lenzites sepiaria growing on a spruce roof. Lower, Coniophora with fruit.

In most cases, the rotting found has taken place rapidly, instead of having been, as sometimes supposed, a slow continuous process similar to the rusting of iron or the weathering of stone. Sometimes after the timber has been partly destroyed, the fungus growth is arrested, leaving sufficient strength to carry the load, and, when the rotted timber is discovered years later, it is assumed that destruction has been progressing slowly since the erection of the building.

Dry rot progresses much faster in summer than in winter in an ordinary building which is heated and thus has its air made relatively dry during the winter



Types of fungi—Upper, Merulius lachrymans with fruit—Lower, Merulius lachrymans growing on a pine beam.

months. Moisture produces the condition most favorable for rapid rotting, the rate of decay being dependent on the relative humidity. Relative humidity is defined as the ratio of the amount of moisture present at any given time to complete saturation, or the per cent. of saturation, of the air at the given temperature.

The relative humidity of air in a room, or basement, sometimes is very different in places only a few feet apart. The difference of a few per cent. in the relative humidity is sometimes sufficient to stop the growth of certain fungi.

The effect of moisture is not limited to the air, but extends to the interior of the timber. Weaving room and paper mill timbers are frequently found with a sound shell both inside and out, and the interior entirely rotted away.

That wood destroying fungi cannot grow under water, or with the wood cells filled with water, is proved by many examples. One of the fine points in the successful design of wood stave pipe for conveying water under pressure, is to design its staves so thin that the pressure will keep the wood saturated; then, it is claimed, it will last indefinitely without decay. Wood of great antiquity has been found buried in clay in a perfect state of preservation.

Dry rot, or merulius lachrymans fungus, will grow on the surface of wood at atmospheric saturations from 96 per cent. to 100 per cent. It will grow inside of large beams of susceptible material at a much lower percentage of atmospheric saturation. A possible source of moisture for supplying the requirements of a fungus growing inside a large beam is the decomposition of the beam itself. Chemical analysis shows rotted wood to contain relatively less hydrogen and more carbon than the original sound wood; this would indicate that the hydrogen part of the cellulose or lignine molecule, is more strongly attacked than the carbon part. This would result in the formation of water, if the decomposition is accompanied by oxidation.

The dry rot disease is chiefly carried by direct contact, but living spores carried in the air can take root when they find a favorable resting place. Fungi are frequently carried in lumber and spread by placing it in large piles with scant ventilation.

In examining a building affected with dry rot, the extent of the rotting can generally be estimated approximately by boring test holes into the beams and columns at frequent intervals. If the material is badly rotted, the borings brought out will be in the form of brown powder or mud, according as the wood is wet or dry.

Hammering on the timber with a machinist's hammer is another method frequently adopted. In this way the outer shell of apparently sound beams has been broken through showing the entire destruction of the interior. To determine whether the rot is still alive is frequently a complicated matter. If it is growing on the surface of the wood, the fresh growth of lace-like plants is significant, but the more frequent condition is where the dry rot fungus is growing inside the wood with no outward manifestation. In this case, a strong indication of living fungus is the moist appearance of a freshly cut section.

Prevention of Rot

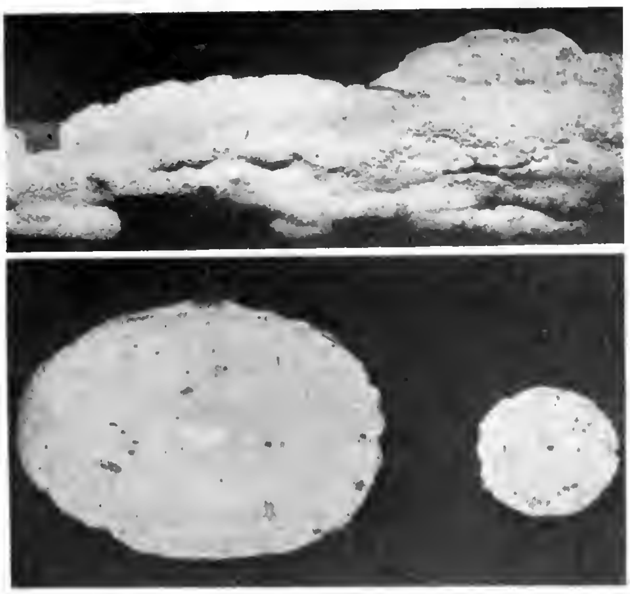
For ordinary building construction the best means to preserve timber from decay is to have it thoroughly seasoned and well ventilated; and if these conditions are secured, there is little danger of rot. Ventilation is generally the first preventative measure suggested. Dry wood, which is placed in an atmosphere well below the moisture requirements of a given fungus, is undoubtedly incapable of infection with that fungus; but, ventilation does not necessarily cause drying, as the wood will become drier or wetter depending on the relative humidity of the air with which it is ventilated. Therefore timber ventilated with moist air may have its rate of rotting accelerated rather than retarded.

A heavy coat of paint may retard or accelerate the rate of rotting, depending upon whether it prevents the wood from absorbing or giving up moisture. The condition most commonly met, in which paint causes rotting, is when it is applied to green timber saturated with water. With dry sound timbers, which are to be placed in a moist atmosphere, a paint will doubtless prove beneficial in proportion to its waterproofing qualities.

It is probable that a very important factor in the resistance of several woods to fungus growth is the presence of some moisture resisting material, such as resin, which prevents sufficient water from being absorbed under the ordinary conditions of atmospheric humidity for the requirements of common fungi. On the other hand, the presence of hygroscopic materials in wood cause it to absorb large amounts of water, in order to maintain equilibrium with the atmospheric humidity, and would render it more susceptible to attack by fungi. "Cold water" or "fireproofing" paints, containing hygroscopic materials, therefore accelerate the progress of rot.

Heat and drying are useful in stopping rot. Often an infected building can be sterilized by skilful use of its own heating system. Merulius lachrymans is particularly sensitive to heat, a temperature of 108 degrees F. for 3 hours or 115 degrees F. for 1 hour, being sufficient to kill it. It is also killed by complete dryness; but ordinary air drying does not kill it. Large beams and girders are better built up and cased, and posts should be bored longitudinally. But even columns with holes through them and the sections of built up beams must be given a chance to season, as the common custom of boring green or wet columns just before they are put in place in a building, and using damp or green lumber for built-up beams, leaves ideal places for the growth of fungus. Holes in columns, moreover, have the objection that they form a convenient passageway for the fungus to move rapidly from floor to floor in a diseased building.

The causes of natural resistance to fungi in wood are obscure and have been investigated but little. Heartwood is generally much more resistant to fungi than sapwood. The presence of starches and sugars in the sapwood, which serve as foods for fungi, as well as the greater water content, are probably the chief causes of its more rapid destruction, while the resistance to water of the heart resin and the antiseptic action of tannin are undoubtedly important functions in the resistance of the heartwood. The limiting power of resin is not absolute, but varies with the moisture, variety of fungus and time of exposure. The resistance of wood to decay does not depend upon any one factor, but is the result of many heterogeneous components acting together.



Types of fungi—Upper, Trametes serialis on a basement beam—Lower, Fomes roseus, a hard rose tinted fungus.

Antiseptic treatment is the only practicable procedure with lumber of doubtful durability because of porosity, light weight, sap or previous exposure to infection, or when it is to be used in a moist place. Much attention has been given to the treatment of railroad ties, posts, etc., but very little study in the past has been given to the treatment of mill timber. The increased life of railroad ties, treated with an antiseptic of 10 lbs. of creosote per cubic foot, is given by the U. S. Forest Products Laboratory as from eight to fifteen years.

The problem of treating timber for factory construction however, is different from that of railway ties or posts. Increased fire hazard, resistance to paint, and a disagreeable odor, are items to be considered, which are of no importance in the case of ties or posts. For this reason, the numerous creosote and tar compounds are often unsuitable. The metal salts, such as corrosive sublimate, are preferable according to all the evidence thus far available. Coal tar compounds are more used for preservative treatments of wood than all other materials together; they act mechanically and chemically, serving as waterproofing as well as antiseptics. The penetration of antiseptics has been increased by the use of vacuum and pressure processes, applied in closed tanks.

Various observations show that liquid oils do not thoroughly waterproof wood and, from all evidence obtainable, fungus is able to thrive about the same on oil soaked wood as upon wood without it.

In building a paper mill or weaving mill, or any structure in which the humidity will be high, antiseptic treatment is well worth its cost with any timbers now available.

Summing up the question of dry rot, and its menaces to timber structures. The variety of fungi causing destruction of buildings are apparently few, and their habits are controlled chiefly by the supply of moisture and the temperature. It is well worth the cost to heat the building as soon as possible after completion. Buy heartwood whenever possible and subject it to a chemical treatment of sufficient strength to kill any latent fungi that it may contain, and to protect the surface from future attack. Also provide good ventilation, and the menace to the safety of structures by dry rot will be largely prevented.

C. P. R. Dam at Moose Jaw Slides on Base

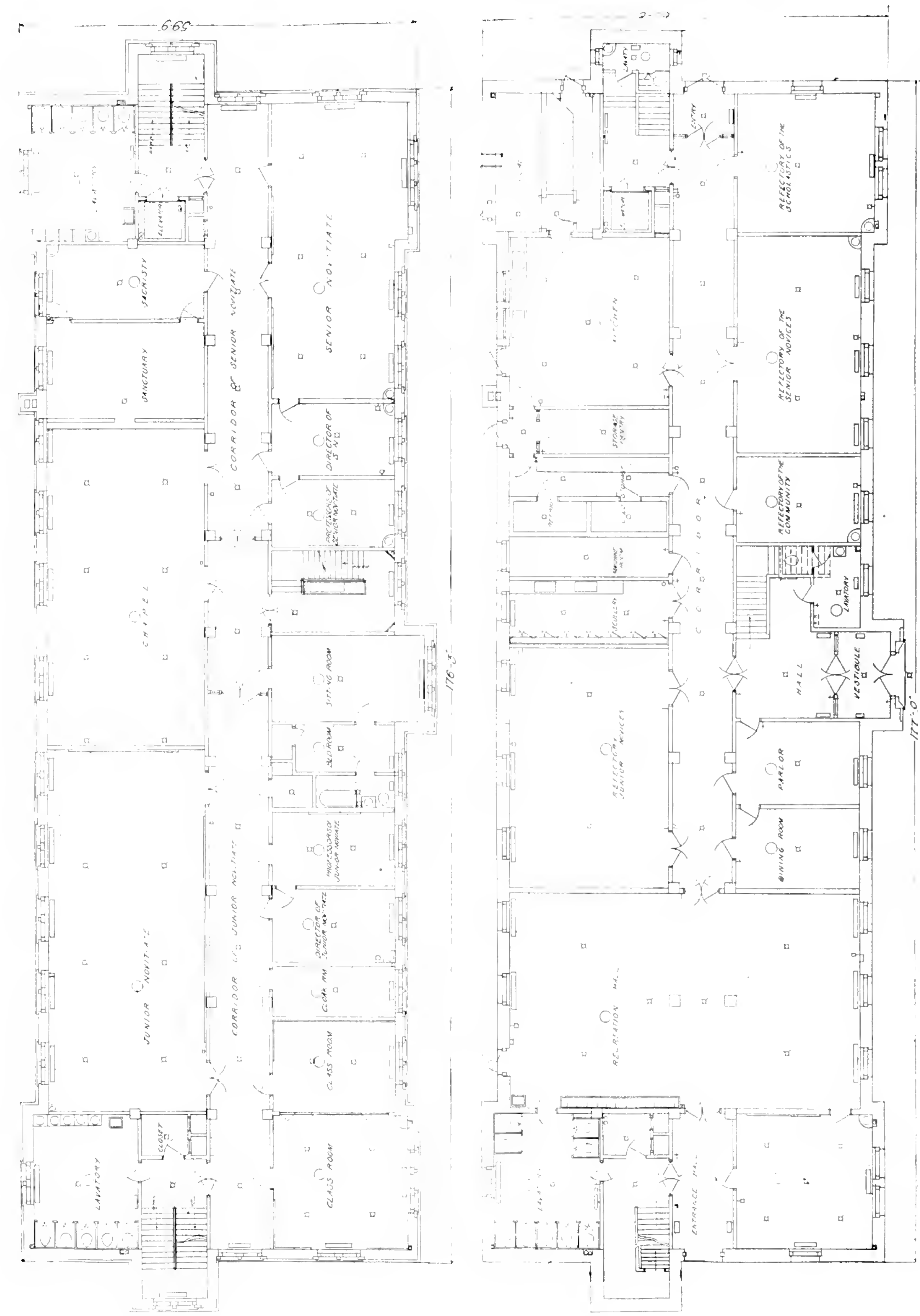
While the water is still too high for a verification of the cause of the accident, it is probable that the failure of the Canadian Pacific Railway's concrete dam at Moose Jaw, which occurred on the morning of April 24, was due to the sliding of the structure upon its foundation. The dam across the Moose Jaw River is of the gravity type, about 300 feet long, divided by buttresses into eighteen sections, nine of which are provided with stop gates. The downstream face had no concrete apron but was protected by stone riprap. The stop logs were all removed at the time of failure.

It is believed that the dam did not break but slid forward about 15 feet on its foundation, due to the washing away of the riprap protection. It is not possible, at this writing, to verify this conclusion. According to old residents in Moose Jaw this year's spring run-off has been equalled only once during the past thirty years, in 1905. In both years of high water the low lying and built-up portions of the city were flooded about 2 feet deep.

Annual Convention of the Royal Architectural Institute of Canada

The General Annual Assembly of the Royal Architectural Institute of Canada will be held at Quebec, Que., on Saturday, 9th September, 1916. All the Canadian architects will be invited and a record attendance is expected. J. H. G. Russell, Winnipeg, Man., President. Alcide Chausse, 5 Beaver Hall Square, Montreal, Que., Hon. Secretary.

The City of Verdun, P. Q., has decided to construct a system of underground conduits, provided a bond issue of $200,000 can be arranged.



Ground (below) and First Floor (above) Plans of the De La Salle Training School, Oak Ridges, Ont.

Hynes, Feldman and Watson, Architects.

De La Salle Training School at Oak Ridges, Ont., Officially Opened

The accompanying illustrations show the prospective and plans of the De La Salle training school at Oak Ridges, Ont., which has just been completed, and was officially opened on May 10. Early in March, 1914, the Roman Catholic denomination purchased 115 acres of land about two miles south-east of Aurora, Ont., as a building site for a training school for the Brethern of the Christian Schools, a school in which male teachers of the separate and other Roman Catholic schools of Ontario should be trained. Plans were prepared and work commenced in October of that year.

The building is approximately 180 ft. x 60 ft., and is of fireproof construction throughout. The walls are Denison interlocking tile faced with common red stock brick with artificial stone copings and trimmings. Foundations and footings are concrete, reinforced with ¾-in. reinforcing bars and dowels. The stone used for mullions and transoms in all windows is artificial stone and the mullions and transoms are filled with solid metal sash, double glazed.

The building contains class rooms, professors' rooms, science rooms and other necessary scholastic departments, and in addition a recreation room, reading room, dormitories, dining room, kitchen, etc. On the ground floor, besides the vestibule, halls and corridors, is a large recreation hall approximately 38 ft. x 56 ft., a parlor, a dining room, refectories for community, scholastics, senior novices and junior novices, a kitchen, pantry, storage room, machine room and coal room.

On the second floor are the class rooms, senior and junior novitiate, with rooms for the directors and professors. A temporary chapel, approximately 50 ft. x 30 ft., with accommodation for 200 people, has been fitted up on this floor. It is the intention ultimately to have a separate building for the chapel. The upper floors are given over to dormitories, bedrooms, infirmary, bath and wash rooms. There are on all floors lavatories at each end of the building.

The building has been made almost entirely fireproof by the elimination of all hardwood floors. Linoleum has been laid directly on the concrete floors and this idea has been carried out even on the stairs. All hall or corridor doors are of fireproof construction. The roof is flat, laid with red promenade tile, and may be used for recreation purposes. There are flights of stairs at each end and in the centre of the main corridor which runs the length of the building on each floor. There is also an elevator, a dumb waiter and linen and dust chutes, to facilitate the work of the attendants.

A brick and concrete power building is built 100 feet north of the main structure and contains the heating boilers, water reservoir tanks, pumps, etc. Heat, light, and hot and cold water are supplied from here to the main building. Electric power, purchased from the Toronto & York Radial Railway Company, is transformed in this building.

The school cost $160,000, and was designed by Hynes, Feldman & Watson, architects, Toronto. Sub-contractors who supplied material and did the erection work were as follows: concrete masonry, Thomson Bros.; carpentry, Geo. L. Robinson; plumbing and heating, W. J. McGuire; plastering, A. D. Grant; painting, Cheshire & Hulme; steel sash, Trussed Concrete Steel Co.; kitchen equipment, Geo. Sparrow & Co. and Murray-Kay; linoleum and electric fixtures, Robert Simpson Co.; tiles, Missisquoi-Lautz Corporation, Limited; wire, A. R. Rice & Co.; ice machine, the Canadian Ice Machine Co., Ltd.

De La Salle Training School, Oak Ridges, Ont.—Hynes, Feldman and Watson, Architects.

A Unique Reinforced Concrete Trestle

A 3¼ Mile Concrete Highway Built with Pre-cast Piles and Floor Slabs—Methods Used in Erection and Transportation

The longest concrete highway trestle ever built is probably that which the State Highway Commission of California have completed over the Yolo by-pass near Sacramento. The highway was officially opened for service a few days ago. The trestle is over three miles long, 20 ft. high, with a roadway 21 ft. in clear width. It is built with pre-cast concrete piles, and the floor is made up of four separate rows of pre-cast slabs placed side by side and spanning the space from bent to bent. There are 2,940 piles and 3,665 slabs used in the construction of the trestle. The method of pile driving, transportation and erection, were unique. The following details of the construction are condensed from articles written by the engineers for the Engineering News.

Existing Conditions

The California State Highway Commission in constructing the highway across the Sacramento Valley had to plan a road which should not be interrupted at periods of flood, which often last for several weeks. It was necessary therefore that the roadway across the Yolo by-pass should be built above flood level and that it should not obstruct the flow of water down the channel.

It was decided that the best and most economical structure to carry the roadway across this channel was a concrete trestle. At one end, however, the final limits of the by-pass channel were not positively determined, and at that end it was decided to build a wooden structure on creosoted piles, which would cost less and be more readily removed in case of necessity than a concrete structure.

The ground crossed by the trestle is a swamp of uniform character, so that it was possible to drive piles accurately and space the bents uniformly. It was decided that the concrete trestle should be built by driving pre-cast concrete piles, four piles to a bent, molding a concrete cap on the heads of each bent and then placing pre-cast floor slabs on these bents, leaving the parapet of the structure and the wearing surface for traffic as the final steps in construction.

For the manufacturing of these piles and slabs a casting yard was located one-half mile beyond one end of the bridge, the site being the nearest location to the bridge that was protected by a levee from the flood waters of the Yolo flood basin.

Concrete Piles

The concrete piles used are 14 ins. square with chamfered corners. There is a reinforcing rod at each corner and spiral hooping. The lower 5 feet of the pile is tapered. Prior to the driving of the piles, numerous test borings and test piles were put down along the line of the trestle. An attempt was made to have all the concrete piles of such a length that they could be driven to the desired grade and afford a resistance to permit a safe loading of 20 tons each.

Piles of five different lengths were cast, as follows: 32 ft. long, 860; 35 ft. long, 1,084; 40 ft. long, 524; 45 ft. long, 236; 50 ft. long, 220. By using these piles of varying lengths it was possible in nearly cases to drive a pile to the final grade desired and obtain the required resistance. The soil encountered was a mixture of sand and clay, with some adobe on top, and varied considerably in bearing power. The penetration under the final blow in some cases was as much as ½ in.; but in others the last twenty or thirty blows lowered the pile only an inch, and in a very few cases it was necessary to cut off the piles.

Reinforced concrete highway trestle 3¼ miles long over Yolo By-Pass, California.

The piledriver was 60 ft. high and was operated by a 8¼ in. x 10 in. hoisting engine with an auxiliary 35 h.p. boiler to supply sufficient steam to the hammer for hard driving. A Vulcan steam hammer was used for driving. This machine had a 3½ ft. drop and 5,000 lb. ram, equipped with cast steel follower. The hammer and follower weighed 5,500 lbs. To carry the piledriver over the soft swamp during the dry weather, 12 x 12 x 24 in. skids were laid directly on the ground with 2 in. x 6 in. greased skidways for the piledriver to slide on. During flood conditions, however, the method was different. A temporary wood trestle to carry the piledriver was driven ahead of the concrete trestle by a small piledriver. The larger piledriver moved backwards after driving a concrete bent and pulled the temporary trestle.

Cushioning the Hammer Blow on the Pile

There were four ⅞-in. reinforcing rods in each concrete pile, and they were left projecting 20 inches above the head when the pile was cast, to make a proper bond

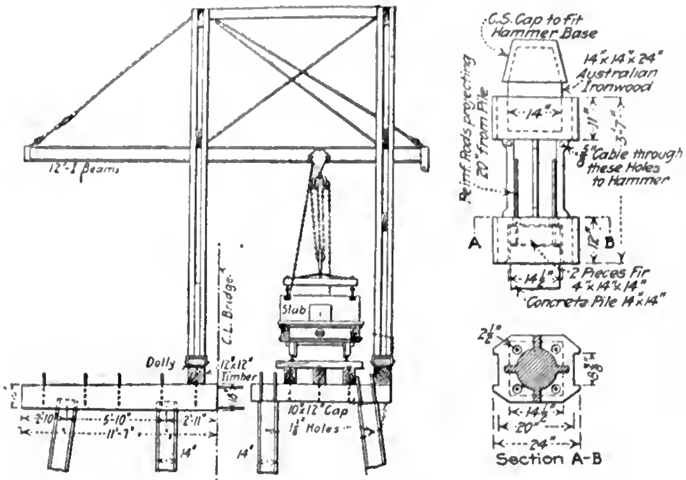


Fig. 2.—Gantry for placing slabs and cap for driving piles.

with the concrete caps, which were later cast in place. These projecting rods necessitated special arrangements in driving the piles to avoid bending the rods. Immediately on top of the piles was placed a 4-in. fir block, or in case of the long piles two blocks, through which holes had been bored for the projecting rods. On top of this wooden block was placed a structural-steel head with a sliding cast block. Later a cast-steel head was used, holes being cored through it to admit the rods. On top of this cast-steel follower was placed a 14 x 14-in. block of Australian ironwood, to receive the blow of the hammer. This block, chamfered at the upper end and fitted with a cast-steel cap, shattered rapidly under the shock of the hammer, lasting from one to five days, or a maximum of about 100 piles driven.

Erection of Trestle

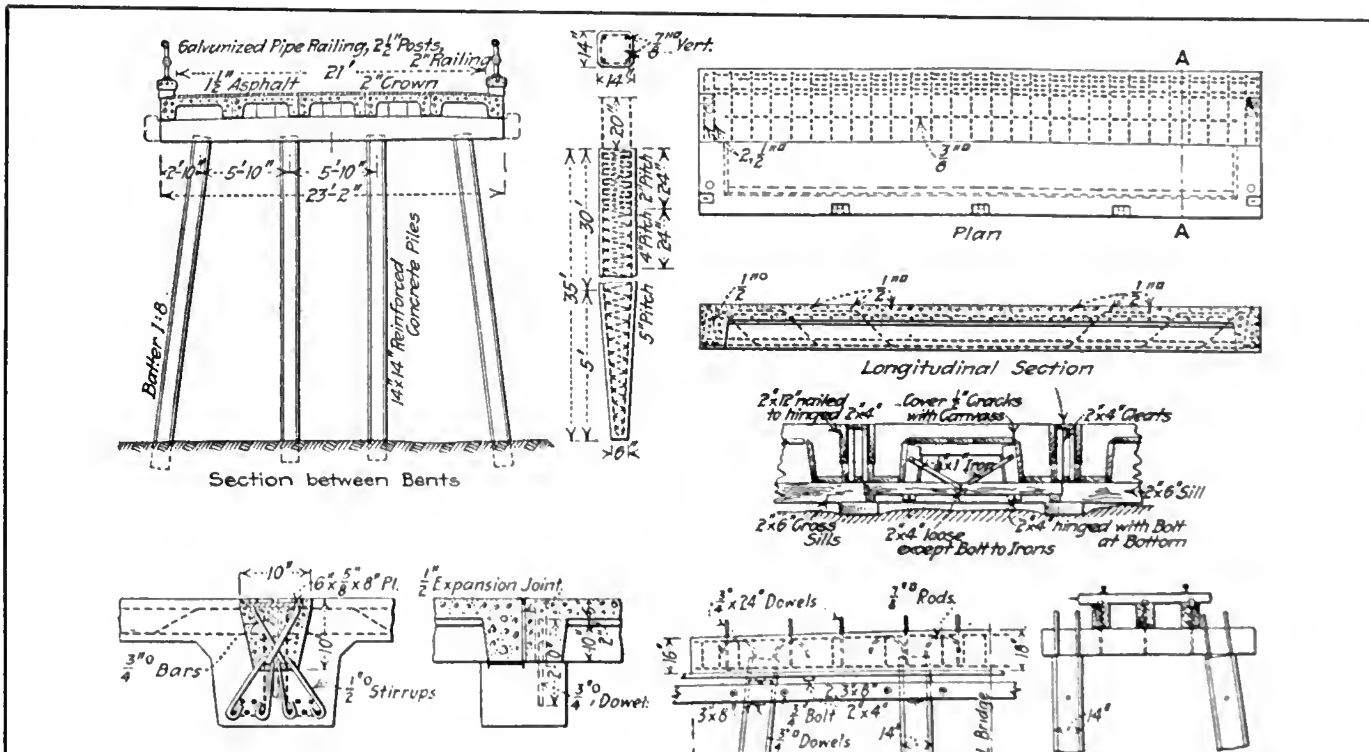
Each bent has four piles, the interior two being vertical and the outside piles having a batter of 1 to 8. As soon as the bent was driven a temporary deck was placed on the two south piles. The deck consisting of a 10 in. x 12 in. cap on which were placed stringers spanning the 20 ft. space from bent to bent, and on the stringers were laid cross ties and an 18 lb. rail for 3 ft. gauge tracks. The next operation was the casting of the reinforced concrete cap on the north half of the pile bent. Wood forms were built around the heads of the piles and the caps poured and allowed to season thirty days. The floor slabs for the north half were then brought from the casting yard, set in place on the caps and grouted. The temporary track was then removed from the south side of the bent to the north half and the south half finished in a similar manner.

Floor Slabs

As may be seen from the accompanying drawings, each floor slab has the general form of an inverted box. The floor is 6 inches in thickness, with projecting flanges of a total depth of 18 inches. Great pains were taken in the design of the slabs and caps, so that the completed trestle is a monolithic structure, although the separate parts are assembled as pre-cast units. Rods were left projecting from the top of the trestle caps, and 3-in. holes were bored in the floor slabs, so that as the floor slabs were set they dropped over these rods. The holes were later filled with grout. At every third bent of the trestle was placed an expansion joint.

For hauling the piles, slabs and other material from the casting yard to the end of the trestle, special cars were used, consisting of two sets of car trucks connected with a reach, and two 12 x 12-in. timbers set on top of the trucks. Two floor slabs made a load for one of these cars, and a train of three loaded cars was pulled by a gasoline locomotive.

For setting the slabs on the trestle cap a gantry crane traveller was used carrying two 5-ton chain



Details of trestle construction, Yolo By-Pass, California.

blocks. When used to set the first row of slabs on the north side of the trestle, the traveller ran on 12 x 12-in. stringers which on one side rested on the inner end of the concrete cap and on the other side rested on the outer side of the cap on the temporary construction track, as shown. To prevent the traveller from tipping, it was chained down when setting the first slab. After this slab was placed, however, a plank was laid on top of it, and then a traveller was used spanning the entire trestle. With these travellers it was possible to set the floor slabs very carefully and accurately. Accuracy in setting was essential, as the bottom edges of the longitudinal joints had to be flush in order to grout these joints. Accuracy in placing the slabs was essential also, on account of the method of fastening used.

In casting the outside slabs for the floor a row of 1½-inch holes 6 inches deep was cored in the slabs. After the slabs had been set, rods 12 inches long were inserted in these holes and grouted in place. These projecting dowels hold the parapet in place on the floor. The parapet is of simple form, 15 inches in height with arch openings. Besides acting as a curb, it supports a galvanized-pipe railing, the top of which is 43 inches above the floor. The wearing surface of the roadway is a layer of asphalt 1½ in. thick. The roadway has a 2-inch crown at the centre, this crown being formed by casting the trestle caps 2 inches higher at the centre than at the sides.

The unit system of construction adopted in building the trestle, not only produced a permanent structure built of uniformly high quality material at low cost, but enabled the work to be prosecuted very rapidly.

A short span bascule bridge has been provided, crossing the navigable channel at the east end. In building the trestle the following amount of material was used: 21,692 tons of crushed stone, 12,553 tons of sand, 32,000 barrels of cement, 8,200 tons of reinforcing steel. These material cost in the neighborhood of $148,000, and the total cost of the trestle was about $395,000.

The Use of Fir Blocks in Pavements

A Committee of Engineers, After Extensive Investigations Decide on Wood Block Paving in Preference to Other Types

A committee of expert engineers, appointed by the municipal legislature of Seattle, after four months of investigation, tests and experiments, recently submitted their report, in which they recommended creosoted Douglas Fir wood block paving on the big East Marginal Way improvement. The engineers spent weeks in actual, physical examinations of different types of street paving, which covered many miles of highways, securing many samples for test figures. In their report they recommended to property owners wood block paving as the best investment. The following is extracted from their report:—

Types Adaptable

"The character of pavements best suited to this class of traffic in this location—practically a water grade—are concrete, brick and creosoted wood block. As it is customary that all paving work done within the city limits should be done under the supervision of, and upon plans and specifications drawn by the city engineer, the county commissioners arranged with the city engineer's department to do this work in the regular way and specified brick paving on a strip twenty feet in width representing 39,000 square yards of paving. This was objected to by the wood block interests on the grounds that a certain percentage of the abutting property owners preferred wood block and that it was an equally suitable surfacing for the improvement. The details of what developed into an acrimonious controversy between commissioners, property owners and paving interests have no bearing on this report, except that it resulted in assurances from the county commissioners that brick block and wood block, and only these materials—would be taken into consideration and the indefinite postponement of their decision. For this reason only these two surfacings have been considered in this investigation.

"In preparing the following table for this improvement showing the comparative values of surfacing, the percentages have been arrived at by using the paving reports of the U. S. Forest Service as a base and making independent investigations to suit the particular conditions and location under which this improvement is to be laid and its probable future duty. The costs include labor and material of surfacing and 6-inch concrete base.

Comparative Values of Surfacing

Qualities	Per cent.	Brick	Creosoted Wood Block
1. First Cost	25	13.0	13.0
2. Maintenance (in which is included annual cost*)	25	18.4	20.6
3. Low Taction Resistance	15	13.4	15.0
4. Slipperyness	10	7.9	5.7
5. Sanitation	10	8.5	8.6
6. Facility for Cleaning	10	9.0	9.5
7. Freedom from Dust, Mud, etc.	5	3.4	4.7
Total number of Points	100	73.6	77.1

	Brick	Creosoted Wood Block
Average cost per Sq. Yd. Laid in Seattle in 1912-14	2.60	2.65
Average cost per Sq. Yd. Laid in Seattle in 1915	2.51	2.45

"In all comparisons city of Seattle standard brick block 4⅛ in. x 3⅜ in. x 3¼ in. with a three per cent. absorption test and Douglas fir block 3¾ in. x 3½ in. x 6 in. to 10 in. with 16 lbs. of creosote per cu. ft. reduced to 12 lb. by vacuum treatment have been used.

First Cost Figures

"The figures for first cost are contract price figures of the city of Seattle and it will be noted that during the last two years there has been a decided equaliza-

* Annual Cost—Interest on first cost plus maintenance cost plus annuity.

tion of the price, the average of the two averages given being practically identical.

"There has, however, been an item properly chargeable to first cost that, as far as your committee has been able to determine has not been charged to the brick cost. This is the cost of sand and planking laid over a new brick pavement in order to avoid its being closed to traffic for from thirty to sixty days and runs in the neighborhood of thirty cents per yard. This charge has not been taken into consideration in the previous schedule of percentages as being pertinent to this particular improvement. The sand sprinkled upon the completed surface of a wood block pavement upon its completion costs about one cent per yard and the wood block is ready for traffic forty-eight hours after completion.

"It must be borne in mind through all these comparisons that the cost of brick block in the East and Central West averages from $16.00 to $18.00 per M., while the same brick at Seattle costs $30.50 per M. and that the treated longleaf yellow pine which is almost exclusively used in the East and South for paving, costs more in those districts than does the treated Douglas fir in Seattle. This makes the first cost of material for surfacing brick pavements in other parts of the country a little less than one-half of the cost here while the cost of wood block is correspondingly higher; a general average for finished pavement being $2.05 per sq. yd. for brick and $3.00 for wood making the ratio two to three for the completed pavement.

Maintenance Charges

"The figures on brick pavement compiled from city data give a maintenance cost of .0299 cents per sq. yd., for something over 1,000,000 sq. yds.; an annual charge of about $30,000.00.

"Figures from the maintenance department of the local street car company for the year 1913 give the cost of maintenance of their portion of the brick paving between Pike and Yesler Way on Second Avenue as $0.435 per yard.

"The records of eighteen other cities in the United States given by city engineers, highway commissioners, etc., shows a decided preference for wood block and a much lower maintenance cost than for brick.

"Your committee can find no facts or figures to substantiate the claim that longleaf yellow pine or other woods are superior to Douglas fir for the purpose under discussion. Records of failure of Douglas fir that your committee have investigated lead to the conclusion that such failures were due to improper treatment or laying, more frequently the latter. Records of failure of brick block as a pavement have shown they have been principally due to the failure of the material itself though in some cass to faulty construction.

"Comparative measurements of the two materials for the same period of use under the same approximate condition show a greater loss of bulk in brick.

"We find practically no difference in the resistance to traffic and slipperyness in the two materials when laid on water grades and with practically no curves in alignment as is the case on East Marginal Way.

"Because of the location and character of the improvement the relative merits of the surfacing of the two materials when compared as to sanitation, facility for cleaning, and freedom from dust, mud, etc., would be about equal with possibly a slight percentage in favor of wood block.

"In summing up the more important considerations which should receive attention in any selection, your committee is in accord with the report published in the December proceedings of the American Society of Civil Engineers, namely, 'That for brick, toughness, resistance to wear from shock or abrasion, and non-absorption are essential qualities. That uniformity of wear is equally important, and may properly be a controlling consideration even at the expense of a moderate sacrifice in the rate of wear. That cement joints when properly made will maintain the integrity of the pavement but uniformity in the cement grout and special skill and care in its application are essential to success. That a sand cushion is necessary only to allow for irregularities in thickness of brick and surface of concrete base and should be limited to one inch or even one-half inch.' From our observations and inspections we find that the brick used in Seattle has apparently deteriorated in quality in recent years along the following lines:—toughness, resistance to wear and non-absorption. We understand that the city testing laboratory discovered some reasons for this deterioration and that the brick block manufacturers have done their best in co-operation to overcome the trouble. However, the new product must be subjected to actual traffic conditions for some years before a more favorable report than is now possible, can be rendered. The city of Seattle specifications call for three per cent. maximum absorption which will in all probability be specified for the East Marginal Way improvement. One and one-half per cent. maximum absorption, in the opinion of your committee, is the proper amount allowable and the amount generally insisted upon in other cities on pavements that will at any time have a heavy taffic duty and the amount which was required for the brick in the recent paving of Second avenue. We have not found that this letting down of the bars has improved the quality and uniformity of wear is not apparent on several of the pavements laid within the past five years.

Fir vs. Pine Blocks

"Continuing to quote from the above mentioned report 'There is no general necessity for confining the material for wood paving blocks to longleaf Georgia or yellow pine, that no necessity exists in the case of wood block pavement, for a resilient cushion, under the blocks, and the reduction in any such cushion, to a layer as may be necessary, safely for the purpose of correcting the unevenness of the foundation and of permitting the immediate compensation for irregularities in the depths of the blocks themselves. That this layer should be of such character as to insure its permanence in the position it occupies when the pavement is opened to traffic. That an excessive quantity of preservative involves additional cost without compensating advantages while if too little is used it may fail of its purpose.'

"We have found in Seattle that irregularities in surface of wood block pavement is due almost without exception to the shifting of an excessively thick sand cushion or to the disintegration of blocks having too light a treatment of preservative.

"To re-capitulate, we have a concrete base, common to either pavement, but above this in the case of the brick there is a cushion of sufficient thickness of more or less unstable material to make its retention in its original place a serious problem. And on this cushion is a wearing surface of material which has not proved uniform and has proved comparatively expensive to maintain. In the other case, on a concrete base we have a cushion so thin and of such a plastic nature as to be easily controlled and a finished wearing surface which has proved uniform in quality and for which the maintenance is exceptionally small.

"Judging from the more recent bids under present Seattle specifications, we believe the difference in cost as between brick and wood will be small. Furthermore, we believe that with changes in the specifications—to secure materials of recognized equality of their respective kinds, the cost will be appreciably less with wood than with brick.

Recommend Wood Block

"From all the foregoing, your committee respectfully recommends the use of creosoted wood block pavement for the improvement of East Marginal Way, and further that the specifications governing same be revised in accordance with the most modern and up-to-date methods and practices.

"Before closing this report your committee feels it their duty to suggest for your earnest consideration, the following: Since for some years East Marginal Way will not, in all probability, be much travelled, since the traffic is not likely to be heavy concentrated loads, and since what ever saving possible should be made to the taxpayers and abutting property owners, we believe it to be to the best interests of those most vitally concerned to install at this time the concrete base, using a surface hardener to take the wear. Such a pavement can be guaranteed to last for at least five years and will obviate the expenditure of many thousands of dollars till such time as the traffic warrants such expense.

"For instance, the cost of the concrete base will be the same in any case; to this add twenty-two and one-half cents per square yard for surface hardener and when the proper time arrives to put on wood blocks, it may be done with no delay and little or no inconvenience to whatever traffic exists. The cost of cushion and wood blocks at present prices is about $1.60 per square yard. If this amount was invested to draw only four per cent. interest, the interest would amount to $0.32 per square yard in five years, or more than the cost of hardener, and with a guarantee the maintenance would be nil.

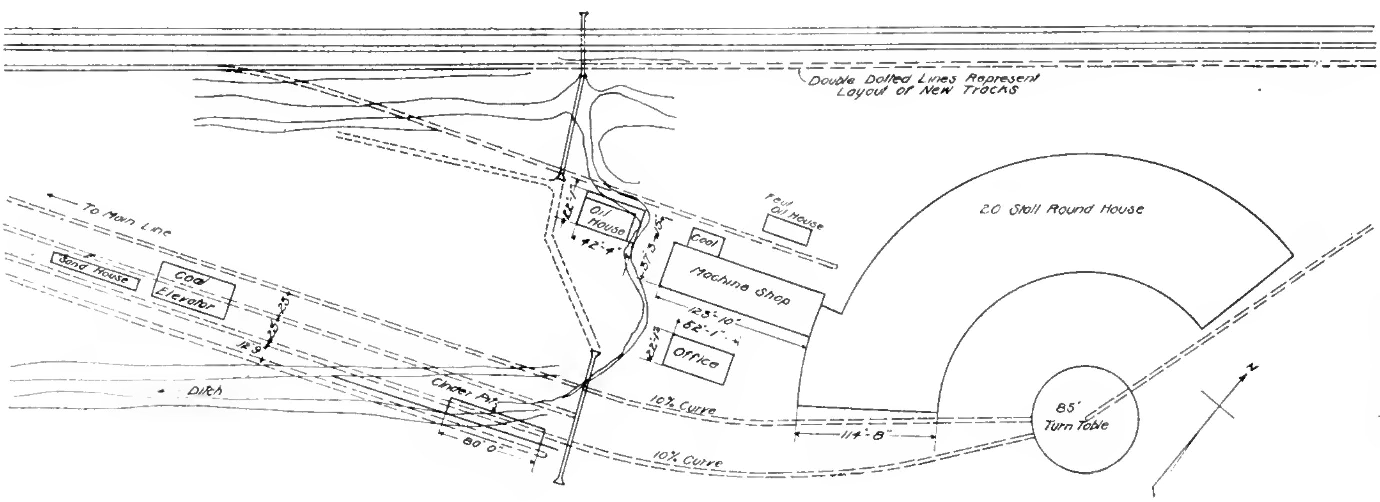
"If at the end of five years traffic it does not seem to warrant the expense of blocks, taxes and assessments will be correspondingly kept down.

Estimates

"In other words your committee estimates that for 39,000 square yards all expenses up to and including the concrete base will be constant for any pavement. For hard wearing surface on concrete, add $8,775.00, for wood blocks, $62,400.00, the difference of which is a saving of $53,625.00. This sum invested for five years at four per cent. will amount to $64,350.00, as against $62,400.00, estimated to be required. Or figured another way, property owners and taxpayers can be relieved of the interest on $53,625.00 for a period of five years or more, for a road surfacing which in the estimation of your committee is at present an unnecessary expense. These figures are based on the length of East Marginal Way as specified in the original bond issue and not upon its length after connection with Duwamish avenue."

M. C. Railway Terminal at Montrose, Ont.

THE cut herewith shows the proposed layout of the new railway terminal to be built by the Michigan Central Railway Company at Montrose, Welland County, Ontario, this year. The layout includes a roundhouse, machine shop, office building, coaling station, sand house, oil houses, and cinder pit, besides the necessary new tracks. The roundhouse, which has accommodation for 20 locomotives, is to be brick and mill work construction; the plan is an arc of a circle of 140 degrees on a 120 ft. radius circle, inside diameter, 217 ft. 8 in., outside diameter, that is, the width, is 97 ft. 8 in., which enlarges to 114 ft. 8 in. where it connects with the machine shop. There is an 85-ft. turntable in front of the roundhouse connected with three outgoing tracks to the main line. The machine shop, which is connected directly to the roundhouse, is 123 ft. 10 in. x 37 ft. 3 in., and together with the office building, which is situated in front directly south of it, will be built of brick. The oil houses will be of reinforced concrete fireproof construction. The terminal is expected to be completed by the fall.



Proposed layout of the M. C. R.'s New Terminal at Montrose, Ont.

The Adaptability of Paving Materials

To Different Conditions and Localities—A Good Opportunity for Utilization of Local Materials

By F. C. Pillsbury*

The adaptability of road paving materials to different conditions and localities when thoroughly considered embraces a very wide field. The subject, if taken literally, does not permit limitations, and I assume it is desired to be as comprehensive as possible. It should be borne in mind that few, even of the highest authorities, have had actual and thorough personal practice and experience except within more or less limited territory, and on this account it is well to emphasize that the practice which might be excellent in one locality would fail at some other place.

The pavement or surface of the road, to be thorough in the consideration of this subject, must be considered as the whole of that portion of the road which is, artificial or natural as the case may be, to its full depth, serving the purpose of carrying the traffic. It is not safe to attempt to decide upon the selection of any wearing surface without giving due consideration to those parts lying immediately beneath, and which are generally termed, (1), the base or bottom course, and (2), the subbase or foundation, also to the nature of the ground upon which the whole is to rest.

The selection of pavements and road surfaces is a subject which has been fully and ably covered a number of times, so there is little to add that will be of interest unless it is taken up from a different point of view, which may be done by considering in an elementary way some of the rudiments and their general applications, under different conditions and in different localities. These conditions may be classified under the following two headings which seem to represent the predominant factors—climate, including its principal conditions of temperature and moisture, and traffic.

Climatic Conditions

The climatic conditions at all times affect all kinds of surfaces. The effects are exceedingly various and not due to, nor are they to be measured by, the changes in temperature or moisture alone, but also according to the traffic and the nature and qualities of the kinds of materials used. A high temperature has a tendency to soften bituminous materials; a low temperature to make them brittle, with a tendency to break. Moisture becomes absorbed, thus causing expansion, while high temperatures as well as extremely low temperatures increase this result, and medium low temperatures generally cause contraction. In some materials these physical changes become very serious, frequently causing destruction when not taken into account. The chemical conditions following the changes of climate are usually so indefinite and of such slight consequence that they need seldom be taken into consideration. Materials should be of such nature as to carry the traffic with the minimum effect of these climatic changes. Some surfaces would be satisfactory in certain climates and would fail in others. Certain materials might be used in one climate and would fail utterly under similar conditions in another climate, while the same type of pavement made of exactly the same material to answer similar requirements would be successful if constructed by different designs, taking into account the effect of the climate. For instance, the thickness of certain types of pavement should be much greater when subject to frost than in climates where there is practically no freezing.

The necessity of providing for the requirements of traffic is imperative and the materials which will sustain traffic in a hot climate may not answer in a cold climate, and vice versa, although certain materials may be manufactured and so used that the changes of climate will have very little effect upon them. These include stone block, wood block, brick, broken stone, and other minerals of more or less solid nature as well as some bitumens, these latter, however, acting like Portland cement as cement or binder. Portland cement concrete is apt to break up from expansion and contraction following extremes of wet and dry or heat and cold. Asphalts and bitumens should have a very low penetration, that is, be quite well solidified when used as a cement or binder in warm climates, otherwise they become softened under a high degree of temperature. This is always to be considered, to a certain extent, in any climate. Bitumens should never be of such a nature or quality as to become brittle when cold. Certain asphalts are less likely to be affected this way by low temperature than others, and probably nearly all of them might be prepared so as to retain the necessary degree of plasticity when cold, at the same time having sufficient stiffness when subject to a high temperature. Certain proprietary and patented compositions, consisting mainly of matter with which it is necessary to use bitumen, are as little affected by changes in temperature as the very best asphalts, but on the other hand they are probably readily affected by moisture.

Other Requisites

While there are certain other requisites such as those related to hygiene and aesthetics, these are not usually necessary requisites, inasmuch as they do not have to be provided for in determining the choice of materials, except as secondary considerations. Nearly all first class pavements and road surfaces can be easily made sanitary, practically dustless, and reasonably free from mud, and will remain so if properly designed and cared for, considering traffic and natural conditions only. Aesthetic requirements are related usually to park systems and private roads, although they should not be forgotten in connection with public highways. They are almost always satisfied by the results obtained from an excellent surface and the surroundings of the road, such as tree planting, roadsides, etc. Noise, however, depends directly upon the kind of traffic and cannot always be easily overcome. There is little excuse for the very rough and uneven stone pavements which exist in many of our cities. Stone pavements can be so constructed and maintained as not to be seriously noisy, and the tendency is toward smoother pavements. Noise is a serious consideration in cities and should always be avoided so far as possible, but in these days of mechanical vehicles there seems to be more of an opportunity to overcome noise in the vehicle itself due to the condition of the vehicle rather than the condition of the street. There is an-

* Division Engineer Massachusetts Highway Commission, before the American Good Roads Congress.

other condition, but this is related more directly to traffic, and that is non-slipperiness for horses. While this is also a secondary consideration except in extreme cases and on steep grades, it should ever be kept in mind and both design and materials be provided to reduce the slipperiness to a minimum. It can be overcome to some extent by the reduction of grades and flattening of cross sections, also banking curves. The entire elimination of slipperiness cannot be accomplished without extraordinary cost, except on those roads subject to very light traffic or in warm climates. It would seem unreasonable to attempt to overcome, in the design or choice of material, the occasional slipperiness due to icing of the surface. It is possible by sanding and frequent cleaning, when the grades and cross sections are suitable to reduce the slipperiness to a reasonable state. It would be possible to construct bituminous pavements with surfaces so rough that they would not be slippery, but such surfaces, on account of their roughness, would be subject to those forces which naturally result in wear and would lead to abnormally rapid destruction.

There are so many known materials adapted for use in paving road surfaces that they are almost numberless. If this be true of those materials that are known, how many must there be that are unknown! This vastness in variety, however, seldom applies to a selection in any given locality. Usually the problem is not an extremely difficult one for an experienced engineer provided he is not limited unreasonably by the local demand, financially, or in other ways. The writer has observed that the highway laws in the United States are generally so imperfect and the highway organizations of the various communities in the states so irregular and incomplete, that many times wisdom is not displayed in the selection of types of pavement and materials with other matters relating to the same. The development of this whole question has been so rapid and it is continuing to develop so extensively that the general public as well as many of those actually engaged in the work have failed to realize the changes that are demanded in almost every way. This condition is not surprising, but is to be expected. Much can and should be done to increase the knowledge of those upon whom the work will fall, as well as the general public.

In the question of the selection of materials, as far as they are influenced by these main considerations, it matters little, as to the quality of material or actual design of the pavement, whether the location is in the country or in the city. These variations in location should be subject to the same methods of treatment, in providing for the effects of traffic and climate, all other requisites, of course, being taken into due consideration.

It is a coincidence worth remarking that road pavements are with few exceptions composed of materials taken directly from the earth, usually without great change in composition, and used for a purpose that requires their being placed back again on the earth, and hence to a degree are subject to the effects of the same natural forces as before their removal from the earth. When exposed to the weather, as road surfaces are exposed, the effects of natural phenomena on these materials are greatest. It has been said, and truly, I believe, that the wear of a road surface might be one half due to the effects of weather and one half due to traffic. The weather, through which climate is mainly evident, is working all the time, and almost always for the deterioration of the road surface. This is not always given due consideration. Having in mind as far as practicable all these requisites and conditions, the writer gives the following list of natural materials, together with some of their common uses, but he believes the competent road designer should be able to go still further and invent—if that word is not an improper one to use in this connection—new combinations or methods which it will often be found advantageous to adopt.

It is not practicable to enumerate here all the different materials, but almost all, and enough for the purposes of this paper, are included in the following:

Natural Materials

Loam, by which is meant that fertile covering of most portions of the earth, composed principally of clay, fine particles of sand, and vegetable matter; sand including all so-called sands, from the finest to those in which there are no particles over ¼ in. in size; gravel, meaning masses composed of fragments of rock loosely mixed with more or less sand and sometimes including a small quantity of loam or clay, the particles of rock being either worn smooth and round or of any form to that sharply angular, often more or less coated with clay or marl, but never compacted so closely and firmly in a solid mass as to be confused with bowlder clay or the hardpans; clay, including pure, fine clays, marls, and earth consisting of more or less clay, found in dense and compact masses with fragments of rock of any size, including bowlder clay and clay hardpan; stone or rock, meaning all kinds of stone materials, not including those minerals classified as sand, gravel, clay, etc., and any ledges, boulders or stones when separate from masses of clay or gravel; bitumens, including asphalts, oils and tars; wood; and shells.

At the present time these natural materials are used in many ways and in innumerable combinations. There is unlimited opportunity for development in use and composition, even to the extet of the discovery of some method or material or combinations of the same absolutely new, and perhaps possessing certain qualities that would accomplish more of the results required than any material in existence at present.

The more common uses of these materials are so well known that it is unwise to include many of them in a paper of this kind, but it may not be uninteresting to discuss those cases which are connected with conditions which should govern the selection and which are sometimes in dispute or not generally known or perhaps not recognized as being of importance. This the writer will endeavor to do, taking up the subjects in terms of the natural materials and others, as already defined, and considering not only their fitness, but dangers to be avoided when improperly used or allowed to remain in risky positions.

Loam or loamy material is seldom of value, particularly in climates subject to much moisture or cold. In these climates, however, it is sometimes used as a binder under certain conditions with sand, gravel or broken stone and with bituminous mixtures. Even this use is to be avoided when the cost of other materials which would answer the purpose is not prohibitive, because the value of the loam lies alone in the fineness of its particles, which enables it to act as a filler. It is so quickly acted upon by moisture, frost, wind, etc., that it has practically no stability. In climates subject to frost action, except where it is very slight, loam should be eliminated as much as possible from use in the pavement material and should not be allowed to remain in its natural position in the roadbed within less than 12 ins. of the bottom of the base unless the road is to be subject to very light traffic, because its instability and tendency to decompose cause the surfacing above to become driven out of place and broken up. A macadam, either water bound or bituminous, is more disastrously affected in this way than gravel, as the gravel surface is somewhat loose and is not ruined even if it does go out of place, whereas the crust-like formation of macadam or bituminous surfaces is liable to breaking and to greater difficulty in restoring afterward.

Loamy materials readily absorb, and generally after absorption retain for a long time, moisture which when present in great quantity leads to tremendous expansion on freezing. This becomes a very destructive condition, under any pavement, and if it is not possible or expedient to avoid placing the pavement on or too near the loam, every possible means should be taken to keep the water out of it.

Work Started on the Extensive Winnipeg Building Program of the T. Eaton Co.

On March 3, the T. Eaton Co. Limited, of Toronto and Winnipeg, submitted to the Winnipeg city council for approval, plans and specifications for a mammoth twelve storey building, and extensions and improvements to the existing premises. The plans were referred to a joint committee of the Water Works and Fire, Water and Light committees, since the permit would have to be a special one, due to the fact that the building could not conform to the present building bylaw of the City of Winnipeg, which states that no building shall be higher than 108 ft., whereas the plans for the new building call for a height of 215 ft.

This excessive height for a twelve storey building is due to the fact that the owners insisted upon special attention being paid to the matter of ventilation. From floor to ceiling, the basement is 18 ft.; ground floor, 20 ft., which is equal to two storeys in an ordinary office building; the second and third floor, 18 ft.; the next five, 17 ft.; and the balance 16 ft. There were a few other minor details which were not in conformity with the building by-law, but the plans were passed by the special committee of the Winnipeg city council. Speaking on behalf of the Timothy Eaton Co., Mr. McGee assured the council that, not only would the premises when completed be a credit to Winnipeg, but the firm had undertaken to do everything possible to make the store the finest on the American continent.

The scheme comprises a series of connected structures, twelve storeys in height, replacing the present nine storey building. When complete it will take in the whole area of the city block, between Graham Ave., St. Marys Ave., Donald and Hargrave Streets. Two bridges, 3 ft. from the ground and nine storeys high, and sundry tunnels under streets, will connect the buildings. The bridge across Graham Ave. will be a means of life saving by allowing communication from one building to the other in case of fire. The work is to be done in units with the entire scheme extending over a period of eight or ten years. The whole proposition will involve an expenditure of approximately $6,000,000.00.

The plans and specifications for the building were prepared by Graham & Burnham, architects, Chicago. The building is to be Tyndal stone from the ground to the top of the second storey; the remaining storeys to be of buff face brick. The structures will be fireproof, with stairs and elevators enclosed, sprinkler system, conveyor, and the most modern equipment for department store convenience. Water storage to the extent of 150,000 to 200,000 gallons will always be available, and the pumping facilities will be of the most up to date kind.

The work at present in progress is the erection of the warehouse section. The foundations are designed for twelve storeys, but of these only eight will be built this year. It will have three fireproof stairs, two 12 ton elevators with platforms large enough to accommodate loaded motor trucks, eight freight elevators—7,000 lbs. capacity each, and two elevators for combined freight and passenger service. Spiral chutes will be installed for conveying packages to the main floor and basement, belt conveyances being used for

Architect's perspective of the T. Eaton buildings, Winnipeg, when completed—Cost $6,000,000.

bringing goods over the main store through one of the tunnels. In fact, every modern labor-saving device will be installed.

The contract for the warehouse was let the very day the city council passed the plans, and the next day the contractors were excavating for the foundation work. At present the trenches for the retaining walls on the east and south ends on Graham Ave. and Hargrave Street, are finished, and pouring cement in these sections has commenced. The north and west walls will not be dug until excavation is completed. Basement excavation is about half finished; work on this is very slow, due to the heavy nature of the clay soil; it is expected that it will be finished by June 1. All the reinforced concrete cassions have been completed; these go to bed rock, an average distance of 50 to 60 ft. with a maximum depth of 80 ft.

Progress on the building, which was expected to be rushed by day and night shifts, is being somewhat retarded by the war, and only a day shift is at present employed on the foundation work. The Bethlehem Steel Works, who are rolling the steel, are also engaged in munition work, making delivery of steel somewhat slow. The first of the steel girders is expected early in June, when progress will become more steady and rapid. Some of the grillage has already arrived. Graham Ave. is now closed between Donald and Hargrave streets until the tunnel, on which work is being pushed rapidly, is completed.

The project in its entirety is a vast one, and indicates the confidence of the Timothy Eaton Co. in the future development of the Canadian West. The tendering for the contract was extensive and spirited, several large U. S. and Canadian firms submitting tenders. The general contract of the warehouse was awarded to Carter-Halls-Aldinger, Limited, for $600,000.00, and the Dominion Bridge Co. was awarded the steel work for $200,000.00. There will necessarily have to be considerable quantities of material imported from eastern Canada and the United States, because of the limited list of Manitoba building material, but wherever possible, material will be purchased in Manitoba.

Bed Testing, to Determine Its Supporting Power for Drain Tile and Sewer Pipe

INTERESTING data on the effect of the method of bedding upon the supporting strength of drain tiles and sewer pipe was recently compiled by N. J. Schlick, drainage engineer of the engineering experimental station, Iowa State college. Tests were made on 24 in. pipe with the different types of bedding indicated in the diagram, and were made when the concrete beddings were one month old; only one series of tests were made, and while they cannot be taken as final, they show some very general facts. The following extracts are based on a paper by Mr. Shlick before a recent meeting of the Iowa Drainage Association.

The types of bedding tested might be divided into three general classes, namely, earth beddings, concrete beddings for firm soils and concrete beddings for yielding soils.

The first of the earth beddings, class 1, was made in accordance with the "Ordinary" method described in the "Standard Specifications for Drain Tile" of the American Society for Testing Materials except that the pipe were only bedded to a little above the mid-height. The trench was shaped in the bottom to approximately fit the lower 90 degrees of the pipe and the ditch filling shoveled in without tamping. There was quite a wide range in the supporting strength of these pipe, but the average agreed quite closely with the average strength as shown by standard strength tests with sand bearings. Because of this close agreement the average supporting strength of class 1 is taken as a basis for comparing the strengths developed by the other types of bedding.

The second class of bedding was the "First Class" method described in the standard specifications. The trench bottom was sloped more accurately and was covered with 1 in. to 2 in. of loose top soil before the pipe were laid. The filling was carefully tamped in, especially at the lower ⅛ points, up to a little above the mid height. The average strength of this class was 28 per cent. greater than that of class 1 and there was considerably less variation in the results from the individual specimens.

In the other type of earth bedding, class 9, the pipe were laid in a flat bottomed trench and the spaces between the pipe and the sides of the trench shoveled full of loose earth. No especial care was taken to see that the spaces between the bottom of the trench and the pipe were filled, and examination after the test showed that the filling there was so loose as to give the pipe no support. The average strength of these pipe was 26 per cent. greater than those of class 1. This increase in strength is thought to be due to the frozen condition of the ditch filling material at the sides of the pipe at the time the tests were made. There is reason to believe that this type of bedding will usually give lower strengths than class 1.

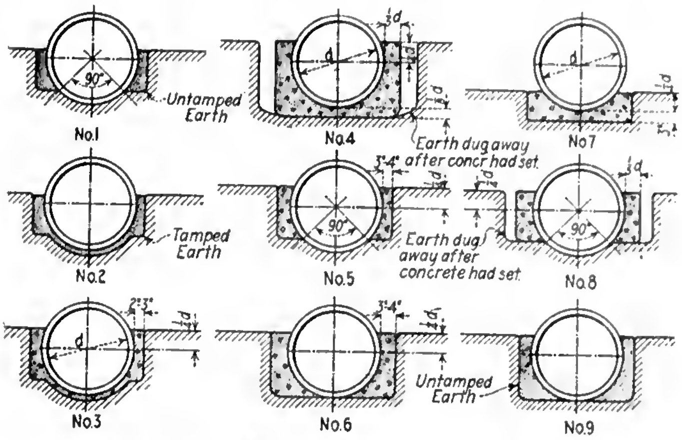
The results of these tests of pipe in earth beddings bring out two especially interesting facts. First: The strength of the pipe laid in the "Ordinary" method agreed very closely with that shown by standard strength tests of similar pipe, and second, that an increase in strength of 25 per cent. can be obtained by more careful bedding, as is specified for "First Class" pipe laying.

None of the pipe in earth beddings would support a larger load than that at which they cracked.

The pipe laid in concrete cradles as specified in the standard specifications for "Concrete Cradles" for "Solid Soils" were tested as class 3. The concrete used was proportioned 1:8. The bottom of the trench was shaped to fit the lower 90 degrees of the pipe and 2 in. of concrete placed on it. The space between the sides of the trench and the pipe, about 2½ in. at the mid-height of the pipe, was then spaded full of concrete up to a height of one-fourth the nominal diameter of the pipe above the mid-height. These pipe had an average cracking strength 64 per cent. greater than those of class 1.

Class 5 beddings were a combination of the earth beddings and the concrete cradle just described. The bottom of the trench was shaped to fit the lower quarter of the circumference of the pipe and the spaces between the pipe and the sides of the trench, about 3 in., filled with 1:8 concrete. These pipe showed a cracking strength of 46 per cent. greater than those of class 1.

The third class of concrete bedding for solid or firm soils was class 6. The trench was dug with a flat bottom and was about 6 in. to 8 in. wider than the outside diameter of the pipe. The pipe was laid in the trench and concrete poured in at the sides, care being taken to get the concrete well around the pipe. Tests



Methods of Bedding, Drain Tile or Sewer Pipe, in Testing for Supporting Power.

of this type of bedding were made with two grades of concrete. In class 6-A a 1:5 mixture was used and in class 6-B a 1:8 proportion. The pipe of class 6-A supported a load 96 per cent. greater than class 1 before cracking. Those of class 6-B developed a cracking strength 80 per cent. greater than that of class 1.

The tests of these classes also indicated that the supporting strength of a pipe after cracking depends upon the bearing power of the soil.

The pipe of these three classes showed a marked tendency to develop side cracks at or near, the top of the concrete at the sides. Where the side cracks in the pipe were below the top of the concrete it usually cracked opposite the crack in the pipe. In each case in Class 3, the concrete was cracked along the centerline at the bottom, the crack appearing simultaneously with the crack in the bottom of the pipe. In a great many cases the cradle was cracked near the lower ⅛ points by the continued application of pressure after the pipe had cracked.

The bedding designated as Class 7 was patterned after the Philadelphia method. This type of bedding or cradle would be equally effective in all soils firm enough to allow of the construction. The trench was dug a little wider than the outside diameter of the pipe and the bottom left flat. About 3 in. of 1:8 concrete was placed the full width of the trench and the pipe laid upon it. Concrete was then placed around the pipe to a height of 6 in. or one-fourth the inside diameter, above the bottom of the pipe. This bedded the pipe in concrete for a little over 90 degrees but furnished no side support whatever, as the top of the concrete was just about even with the surface of the ground.

The pipe of this class showed an average strength before cracking 82 per cent. larger than those of Class 1. As these pipe received no side support, they collapsed as soon as the main fractures were developed.

Tests were made of pipe bedded in "Concrete Cradles" for "Yielding Soils" as specified in the "Standard Specifications for Drain Tile." In Class 4-A a 1:5 concrete was used and in Class 4-B 1:8 concrete.

The trench was dug 10 in. wider than the outside diameter of the pipe and with a flat bottom. A 3 in. layer of concrete was placed in the trench and the pipe laid upon it. Concrete was then poured in at the sides up to the specified height of ¼ the inside diameter above the mid-height.

The pipe of Class 4-A showed an average strength before cracking 38 per cent. larger than those of Class 1, while those of Class 4-B supported 50 per cent. more load before cracking than did those of Class 1. The fact that the cradle of the leaner concrete gave the larger support is attributed to the fact that the pipe of Class 4-B were laid before those of Class 4-A and that cool weather and frosty nights prevailed after the cradle of Class 4-A were poured.

The pipe of these two classes usually cracked at or near the four ¼ points at the same time, though the side cracks were often at or near the top of the concrete. In all cases the concrete cradle cracked along the center line in the bottom, and often at about the lower ⅛ points of the pipe, at the same time the pipe developed fractures. After the cradles were cracked in the bottom, the two sections revolved around the lower outside edges and the pipe would support practically no load.

The bedding of Class 8 were very similar to the combined earth and concrete bedding of Class 5, except that the earth was dug away from the outside of the concrete so as to reproduce as nearly as possible the conditions prevailing when this type of bedding is used in yielding soils.

The concrete used in these beddings was proportioned 1:9. It was poured in cool weather and had developed only a comparatively small portion of its final strength at the time the tests were made.

The pipe of this class had an average supporting strength only 18 per cent. larger than those of Class 1. The concrete received no side support so that the load which developed the cracks in the pipe was the maximum. These tests indicated that this type of bedding would give but little side support other than that due to distributing the pressure over a larger area. In many soils this would result in a noticeable increase in supporting strength but in very wet soils the increase would be small.

These results might be summarized in three general statements, as follows:

1. The suppoting strength of tile laid in the "Ordinary" method is practically the same as the "Ordinary Supporting Strength" shown by the standard tests.
2. The supporting strength can be increased 25 per cent. by more careful earth bedding and 80 per cent. or 90 per cent. by the use of concrete cradles.
3. The supporting strength after the pipe is cracked depends upon the bearing power of the soil at the sides of trenches, irrespective of the type of the bedding.

In our description of the new Administration Building of the Hydro-electric Power Commission of Ontario in the May 3 issue of the Contract Record, we stated that storage batteries were installed for telephone and auxiliary lighting service. This should, of course, have read only for telephone service.

"Why don't they keep the streets a little cleaner,"
You ask with deep annoyance not undue,
"Why don't they keep the parks a little greener,"
Did you ever stop to think that THEY means
YOU?

First Church of Christ Scientists Dedicate a New Church at Winnipeg, Man.

New First Church of Christ Scientist, corner of Nassau St. and Water Ave., Winnipeg—Cost $100,000.

First Church of Christ Scientist

The First Church of Christ Scientist have made a notable addition to the churches of Winnipeg in their new building on the corner of Nassau and River Streets, which was recently dedicated for service. The new edifice is in the simple Greek Ionic design of architecture, built on the plan of a Greek cross. It is simple insofar as the exterior design is concerned. The foundations and exterior trimmings are Tyndall stone, while the exterior walls are buff-colored face brick.

The general idea of the Christ Scientist churches, to provide a large foyer for a meeting room wherein members may intermingle before and after service, has been carried out in this church. A cloak room has also been provided just within the main entrance. The main auditorium is above the level of the street and is accessible by four stairways. It is fitted with mahogany pews with accommodation for about 1,100 people. The floor slopes gradually toward the reader's platform. The organ loft is directly back of the reader's platform, and the organ will, when installed, be entirely obscured by a grill-work screen. The artificial lighting of the auditorium is carried out from the alcoves entirely. There is a Sunday school below the auditorium with seating capacity of 300.

The new church was designed by Jordan & Over, architects, Winnipeg, and built by the Fort Garry Construction Company at a cost of approximately $100,000.

Steam shovels—Circular No. 14, by the Osgood Company, Marion, Ohio, describing, with illustrations, their "18" ¾ yard, traction, revolving, steam shovel, adapted for sewer trench excavating only.

Concrete Street Railway Track Foundation Construction

The scarcity of permanent street railway track construction in many cities has been chiefly due to the fact that railway companies prefer to build some sort of temporary construction, which can be easily taken up to make repairs to the track, rather than lay any permanent type.

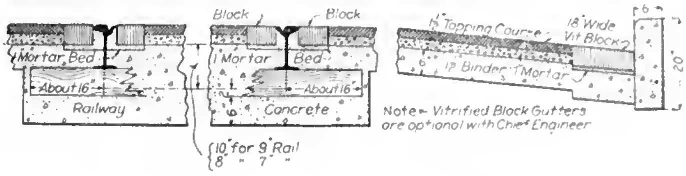
These temporary forms of construction have been the cause of a great deal of difficulty to street paving contractors in paving the remaining allowance of the street. Vibration due to poor foundations soon cracks the pavement near the rail, and requires repairs much sooner than would otherwise be necessary.

Mr. R. Keith Compton, chief engineer of the Baltimore Paving Commission, outlines in a paper read before the recent Pittsburgh Convention of the American Road Builders' Association the situation in Baltimore, how it was remedied, and the joint form of construction as carried on by the street railway and the paving contractor.

In the beginning of the year 1914 the situation in the city of Baltimore was thoroughly studied, both by the municipal engineers and the traction officials, with the result that the State Legislature of Maryland was appealed to by the municipality and a law was passed putting the character of foundation under the ties of the several street railway companies and steam railroads under the jurisdiction of the Paving Commission, with power to decide whether such foundation should be of plain ballast or concrete. The Commission decided that in heavy traffic down-town streets concrete construction, 6 in. thick, under and around the ties, was necessary, but that in the outlying suburban sections where the traffic is light and street development more or less of an uncertainty, awaiting property development, rock ballast could be used.

Work Together

The forces of the railway company and that of the paving contractor work in conjunction. The railway area is first graded out to the subgrade of the paving by the paving contractor. The railway company then takes charge and grades out to a point 6 in. below the bottom of the ties. New rails and ties are then installed where necessary, together with any new special work. The ballast is then placed and thoroughly tamped under the ties and up to a point 2 in. above



Form of track foundation construction used in Baltimore.

the bottom of the ties, the rails are brought to the proper grade and line, and when the entire construction is "tight" the penetration begins.

The grouting mixture is composed of 1 part cement to 2 parts sand, and is of about the consistency of thin cream. The mixture is applied without interruption to car traffic by the use of a small continuous mixer placed just outside of and parallel with the railway tracks, with a flexible chute, in two sections, to convey the grout from the mixer to the ballast. Starting on the downgrade end and working upgrade, the thin grout is penetrated into the stone ballast. When a car comes along the first section of the chute is thrown out of service and the second section is lowered to the ballast at about the ends of the ties and the mixer kept in service. After the car passes the first section is thrown back in service.

During this operation some movement occasionally occurs in the tracks, but there is a city inspector on the work at all times who hunts for and locates loose ties and they are immediately tamped up with green concrete.

The natural supposition is that sufficient movement of the ties and track would occur to injure the concrete while setting, but this is not true if the work is carefully handled and executed. On one street in Baltimore this work was successfully handled with five different lines of cars passing up and down the street with but 20 seconds headway at times during the day, while on another piece of work it was successfully handled with eleven different lines of cars passing over the special work with less than 20 seconds' headway at short intervals during the day. The resultant mixture is about 1 of cement, 2 of sand and 5½ of stone, with the concrete very dense, as the ballast has been thoroughly tamped and voids reduced to a minimum.

This ends the work of the railway company, as after this section of concrete is installed, the paving contractor again takes charge, installing the concrete base for the pavement immediately on top of the railway base, and then the paving.

As a rule, there is no bond between the paving slab installed by the railway company and the paving base installed by the paving contractor, because generally the former is several blocks ahead of the latter, and in the meantime the concrete slab has set.

One of the principal points gained by this form of construction is that it shows up very clearly every weak place during the progress of the work. All loose or poorly tamped ties are made apparent by the bubbling or oozing up of the grout as a car passes over. Failures in finished pavement are avoided by immediately tamping such ties, which in many cases would otherwise be overlooked. It has been found by careful cuts made in the finished work that this grout when properly applied penetrates the ballast to the subgrade, forming excellent concrete, and insures solid track construction, free from vibration.

From records kept and compiled by the Paving Commission it has been found that the total extra cost of this construction over plain ballast, including labor and material, is about 52 ct. per lineal foot of single track.

In the last two years about 10 miles (single track) of such construction have been installed in Baltimore by this process, in the busiest streets of the city, and our traffic interfered with to such a limited extent that no complaints whatever are heard from the traveling public during the course of the work. Included in the 10 miles of single track will be found all classes of paving within the railway area—sheet asphalt, wood block, granite block, vitrified block and scoria block.

In order to obtain good results with the penetration method, every detail must be carefully looked after by the inspectors, such as the quality and size of the stone composing the ballast, the tamping, and the mixing and placing of the grout. Frequent test holes should be cut in order to see that thorough penetration is secured, and wherever possible the penetration should be started at the downgrade end of a block and proceed upgrade.

To Supervise Elevator Construction

The John S. Metcalf Company, Montreal, have been retained by the State Governments of New South Wales and South Australia to make plans and supervise the construction of elevators for the bulk handling of grain. The same firm has also submitted a report to the Victoria Government. New South Wales proposes to erect a terminal elevator at Sydney with a capacity of 3,000,000 bushels; a terminal elevator at Newcastle with a capacity of 500,000 bushels and approximately 200 country elevators with varying capacities from 25,000 to 200,000 bushels. As the normal wheat harvest in Victoria is about equal to that of New South Wales, it is assumed that the elevator requirements of both states will be about equal. South Australia proposes to erect four terminal elevators with capacities ranging from 500,000 to 1,000,000 bushels, and about 110 country elevators of varying capacities. The John S. Metcalf Company have supervised, for the French Government, the building of a number of temporary elevators at some of the ports.

The Turbine Equipment Co.

The Turbine Equipment Co. have been awarded a contract to supply 4, single stage, De Laval, centrifugal pumps, capacity each 3,750 gals. per minute against a 95 ft. head, to the Imperial Oil Co. of Sarnia. The pumps will be direct connected to 75 h.p. motors. The Standard Chemical Co. of Toronto have also purchased a De Laval centrifugal pump, capacity 1¾ million gallons, to operate against a 125 ft. head.

Damp-proofing and Water-proofing

The Methods and Materials Used to Prevent the Disintegrating Action of Water on Completed Structures

By S. G. Webb*

The general subject of structural dampproofing and waterproofing as it confronts us to-day involves the methods and means of protecting structural materials against the disintegrating action of water. Masonry building materials are generally more or less porous and capillary in their structure, permitting the absorption and permeation of water. The presence of water in masonry is structurally injurious, due to its solvent action on any soluble content, but more particularly its disintegrating action by the expansive force that is manifested by the congealing of the water on freezing. While the subject of structural waterproofing and dampproofing deals primarily with the prevention of gradual decay and disintegration of structural materials, it also performs the useful and necessary function of providing more hygienic conditions for the benefit of humanity in general.

The subject of the protection of structural materials against the disintegrating action of water should, for the most comprehensive understanding, be considered under the two general divisions of waterproofing and dampproofing. The term waterproofing should correctly be confined to the consideration of methods and means of protecting subterra construction and structures intended for retaining and containing water under and against hydrostatic head. Consistent with this definition, the term waterproofing as a part of this great subject would apply directly to the methods of treating foundations, tunnels, reservoirs, cisterns, standpipes and similar construction. The term dampproofing should correctly be confined to the consideration of the methods and means of keeping water and dampness out of the superstructure of buildings. In accordance with this definition, dampproofing should involve the various methods of treating exposed walls above grade line to avoid the entrance or penetration of moisture and dampness into the structure.

Dampproofing

The subject of dampproofing, which we have already defined as correctly applying to a consideration of methods and means of keeping water and dampness out of the superstructure of buildings, may be very simply sub-divided into the three following classes, viz.:

A—Transparent coatings and treatments.
B—Opaque decorative coatings.
C—Special bituminous coatings.

Again, the above classification of dampproofing treatments may be further sub-divided. The method involving the use of transparent coatings may be subdivided into three quite characteristic sub-heads, viz.:

(1)—The Sylvester process.
(2)—Hot paraffine and waxes.
(3)—Special proprietary products.

(1) The Sylvester process is one of the oldest dampproofing treatments, and while it has been used to some practical extent, it is at the present time very seldom considered. The Sylvester process provides for the alternate treatment of a porous masonry surface with solutions of soap and alum. These solutions are preferably applied hot so as to insure good penetration and to accelerate the chemical reaction between the two materials. The theory of this treatment is to provide by inter-reaction of the soap and the alum, an aluminum salt of the fat contained in the soap, which will be deposited in the pores of the surface and tend to repel the moisture.

(2) The second classification of transparent dampproofing treatments covers all of the various methods which have been proposed and used, involving the heating of the masonry surface and the application of melted paraffine or wax. While a dampproofing treatment of this type can be made very effective its application is necessarily limited to only special cases where the high cost of its application is not prohibitory. The application can only be made slowly, as the surface has to be heated with a blow torch, and only when at the proper temperature can the melted paraffine or wax be applied to insure the proper penetration and absorption of the repellent material into the pores of the surface.

(3) The third class of transparent treatments, viz., special proprietary products, suggests quite an interesting and unfortunate chapter in the history of the development of the general subject of the preservation of structural work against the disintegrating action of water. Following the general recognition that one of the objections to concrete construction was its absorbent nature, there appeared on the market an almost innumerable number of transparent liquids presented with the most extraordinary and extravagant claims.

Early Products Inefficient

Practically all of the earlier proprietary transparent dampproofing products were nothing more or less than low melting point paraffines or waxes which had been melted and fluxed back into a volatile solvent. The theory of such a preparation is entirely correct, but unfortunately these several paraffines and waxes can only be dissolved in solvents to a very limited extent, producing a product that actually carries a very small amount of repellent base and an excessive amount of volatile material. On application to the surface, practically 90 to 95 per cent. of the original material would be lost by evaporation, leaving only a small residue deposited in the pores of the surface. It would require a number of repeated applications in order to leave deposited in the pores of the surface a sufficient quantity of the repellent base to provide any efficient dampproofing results.

The reason for not making more successful early progress on a transparent dampproofing treatment of this character is unquestionably the fact that the condition is by no means a simple one. A satisfactory transparent dampproofing material that is applied cold with a brush must be one that is practically colorless, as any tendency for the material to stain or discolor the surface is highly objectionable. Nature, unfortunately, has not provided many materials that offer possibilities for producing a product of this kind. The majority of products, when used in quantity sufficient to provide the necessary amount of total solids to give efficient dampproofing results, will impart such a color to the material that when used over stone that is more or less sensitive to discoloration, it will be-

* Sec'y of the Gypson Industrial Association, Inc., before the New York State Builders' Supply Dealers' Association.

come badly stained, and the injury will be more serious than the difficulty which it was originally intended to overcome.

The difficulties which the requirements for such a material presented, and the complaints which followed the use of so many of the inferior products, have resulted in the slow disappearance of a great number of products that originally appeared, and to-day there are only two or three of the materials on the market that were numbered originally among the great list of special products.

It is a problem that has involved a great deal of careful scientific investigation in order to select such materials which, due to their chemical affinity, can be so combined as to produce a synthetic base which has the properties of dissolving in the combination of solvents, to yield a product that will contain a comparatively high percentage of base so that when applied to a surface and the volatile material has evaporated, there will be a sufficient quantity of material deposited in the pores to fill them and change their natural absorbent nature to a negative repellent action.

Opaque Coatings

The second class of general dampproofing treatments, viz., opaque decorative coatings, may be subdivided similarly to transparent treatments affording a very simple consideration of this important part of the general subject of dampproofing. This classification is as follows:

(1)—Various cement washes.
(2)—Common oil coatings.
(3)—Special proprietary cement coatings.

(1) The first conception of applying an opaque decorative treatment is evidenced in the use of a mixture of cement and water applied with a brush for the dual purpose of obscuring any imperfections in the surface and giving an outer shell that is of a denser texture so as to protect the masonry from the penetration or absorption of moisture. While this treatment is more or less effective in uniforming the appearance of the surface, it hardly possesses any great or efficient dampproofing results. This is due to the fact that the cement is mixed with water, and when applied the water occupies a definite volume, and on evaporation leaves the surface full of small microscopic pores and apertures through which water can penetrate.

(2) The second class of opaque dampproofing treatments, viz., ordinary oil paints, has been tried at various times with unsatisfactory results. This is very obviously due to the fact that in contrast to a wood or metal surface, a concrete surface is chemically active, due to the presence of alkali. When a common oil paint is applied over wood or metal, there is no chemical influence to in any way interfere with its normal process of drying to a tough, elastic linoxyn film. When such a product is applied over a concrete surface, the condition is distinctly different.

(3) The third method of opaque dampproofing treatments, viz., specialized cement coatings, offers the greatest opportunity for producing effective and satisfactory dampproofing results. With a full knowledge of the physical and chemical characteristics of a concrete or masonry surface, it is possible to select raw materials and so treat and combine them as to produce a product that is in every sense a specialized cement coating. Such a product cannot be produced by any effort to re-adapt a common oil paint but must be built up fundamentally from special materials which, due to their physical characteristics and chemical properties, are suited for the production of a strictly specialized product.

Bituminous Products

The third class of dampproofing treatment involves the application of bituminous products to the interior of exposed walls. The treatments in the first two classes as outlined above are applied to the exterior of the superstructure; while the special bituminous products are distinct in being applied to the inside of the wall.

These products are black in appearance and usually of quite heavy body, being applied with a brush so as to provide a thoroughly continuous coating. They are characterized by indefinitely remaining tacky, and provide bond for a coat of plaster applied directly to the coated surface. It is to be emphasized that the prime purpose in the application of such products to interior walls is for dampproofing results, and the fact that they have the associated property of bonding a coat of plaster is distinctly secondary.

It has become a very general practice in construction work to provide for the application of such a dampproofing on the interior of all exposed walls, as it gives an element in the wall that will prevent the continuous penetration of dampness or moisture through the wall, which would injure and destroy the interior decorations and produce a damp and unhealthful condition.

The subject of waterproofing proper, as we have defined applying to the treatment of sub-terra construction and structures intended for retaining and containing water under hydrostatic head, may very correctly be divided into the two characteristic methods, viz., integral and membrane, each of which has further sub-divisions.

The integral method of waterproofing involves the addition of compounds to the concrete at the time it is placed, and becomes a unit or integral part of the mass. This method is also known as the rigid method of treatment in distinction to the membrane which permits greater movements and conformation in the structure without injuring the effectiveness of the waterproofing treatment.

Integral Method

The integral method has been received with a great deal of favor by engineers, and its application has been increasing quite rapidly. Various compounds which are used for general integral waterproofing requirements may be divided into two classes characterized by the physical condition in which they are added to the concrete, viz.:

(1) Finely powdered dry compounds which are mixed with the dry cement.

(2) Compounds either in liquid or paste form which are added directly to the water used to temper the dry mixture of cement and aggregate.

The products coming under the first classification may be further divided, due to their characteristic physical properties, into three classes, viz.:

(a) repellent; (b) non-repellent; (c) metallic.

(a) The repellents were the first integral waterproofing compounds to be generally used. These materials are usually the metallic salts of various fatty acids that import their characteristic repellent properties.

In the practical application of these dry repellent powders the material is mixed in proportions varying from 1 to 5 per cent. with the dry cement. The treated cement is then combined with the aggregate and tempered with water to proper consistency. For general concrete operations the repellent properties are greatly limited, due to their repellent action. The presence of quite a large percentage of hydrated lime is essential to serve as a ballast for the repellent material.

(b) The objection which has been taken by the engineering fraternity to the use of repellent products on account of the uncertainty in uniform results, has been a natural incentive to develop products which do not show this repellent action. These products are usually constituted on a basis of hydrated clay, aluminum hydroxide or some similar inorganic colloidal substance. In manufacture they are ground extremely fine so as to develop the largest possible surface area to intensify colloidal development. The partial efficiency of such materials is contributed by their void-filling value. They are also recommended as beneficial in lubricating the mass of concrete so that it flows together in a tighter and closer mass.

The limitations of such materials is due primarily to the fact that the products which are used, while of a characteristic colloidal nature, have not the capacity for sufficient colloidal development to fill out all the voids and apertures of a concrete mass and give a density that is absolutely impermeable.

(c) To complete the classification of various integral waterproofings which are mixed with the dry cement, metallic compounds should be mentioned. These products consist primarily of very finely ground metallic iron, and in their integral application are mixed dry with the cement in a similar procedure to other dry integral products.

The theory of the action of such products is the increase in volume that occurs from the oxidation of the iron. When the process is complete, in place of the fine particles of iron, there is developed the hydrated oxide, which occupies a volume much larger than is the case with the original iron particle. The great difficulty, however, in obtaining satisfactory results with the metallic powders when used in integral application is the fact that cement itself is strongly basic and the presence of the hydroxyl ions developed in the crystallization of the cement naturally inhibits corrosion and prevents the oxidation and development of the iron throughout the mass of concrete, which is essential for efficient results.

Liquid or Paste Forms

The second class of integral waterproofing compounds which are added directly to the water, either in liquid or paste form, has the great advantage of absolute certainty in even, uniform distribution throughout the concrete. These products are generally readily miscible with water, forming a colloidal suspension in the water, and as a result of thorough mixing of the water with the cementing materials, are correspondingly uniformly distributed throughout the entire mass. The compounds in this class may for the most complete consideration be divided into the three following classes:

(2) Compounds in liquid or paste form added directly to water used to temper concrete. (a) Unsaturated colloids; (b) extended colloids; (c) concentrated colloids.

(a) Under this class are included practically all compounds which contain unsaturated fatty acids that require reaction with the constituents of the cement in order to form the final waterproofing compound. These products are usually mixed with the water used to temper the concrete in proportions varying from 1:25 to 1:50.

The great general objection to the use of unsaturated colloids is the uncertainty of the effect upon the tensile and compressive strength of the concrete.

(b) Products included under the classification of extended colloids are not usually characterized by any tendency to enter into reaction with the constituents of the cement, but contribute their efficiency by the characteristic colloidal nature of the compounds themselves.

(c) The products included in this class are a further development of the extended colloids in that they contain only materials of a strictly colloidal nature, which are capable of contributing waterproofing value.

Insulating Membrane

The second general division of the literal subject of waterproofing differs distinctly from the integral method in that it does not attempt to treat the concrete, but rather to insulate it from contact with water by enveloping the structure in a continuous bituminous shield. The fact that the membrane is not a rigid or unit part of the structure permits a certain freedom of movement and action in the concrete without impairing the efficiency of the waterproofing treatment. This feature of the membrane system makes it suitable for waterproofing work not fully reinforced and liable to settlement or subject to vibration or shock, such as a railroad bridge.

It was early practice to simply coat the surface to be waterproofed with hot tar or asphalt, but it soon became evident that this was not sufficient as the coating would crack with any movement in the wall. It was therefore necessary to employ some material in addition to the bitumen in order to contribute the necessary toughness and tensile strength. Burlap and coal tar felt have been extensively used for this purpose and some very satisfactory waterproofing operations have been carried out with such materials. During the last few years considerably more attention has been given to the nature of the waterproofing felt and as a result there are now on the market especially manufactured felts which are both saturated and coated with bitumen and possess greater pliability and strength. By means of these felts more perfect membranes can be constructed as the strength and toughness of the felt permit greater distortion and twisting to accommodate it to the design of the work.

The bitumens most generally used for cementing the felt together in constructing the membrane are coal tar pitch, commercial asphalt and special asphaltic compositions.

Winnipeg Aqueduct Work Proceeds

Sub-contractors on the Greater Winnipeg aqueduct will be allowed to proceed with their contracts, pending the final report of the engineers now employed in making an investigation of the designs and construction, provided that the cement bases of the foundations on certain sections be so extended as to render their stability beyond any question of doubt.

This was decided upon at a meeting of the Greater Winnipeg Water District board, recently, after receiving an interim report from the investigating engineers, who had made a cursory examination of the aqueduct. A more extensive and probably a final inspection of the work is now being made.

Additions to Dominion Sheet Metal Plant

Two additions, 20 ft. x 100 ft. and 40 ft. x 80 ft. respectively, are being made at the plant of the Dominion Sheet Metal Company, Limited, Hamilton, Ont., manufacturers of "Premier" galvanized sheet. This company is sparing no effort or expense to give Canadian buyers of galvanized sheets a steady supply at this time when import shipments are negligible. This result has only been possible by high pressure work on the part of a thoroughly experienced staff and by having provided liberally in advance against present extraordinary conditions. In this connection it might be noted that not a pound of Canadian prime western spelter can be purchased today, though it is hoped that eventually the British Columbia product will be available.

Armstrong Cork & Insulation Company

An interesting booklet has been issued by the Armstrong Cork & Insulation Company, of Pittsburg, Pa., describing their Nonpareil high pressure covering for high pressure and superheated steam lines, boilers, breechings, feed water heaters, tanks and heated surfaces, in more detail than, we believe, has ever been before attempted by a manufacturing company. An interesting feature is a list of comparative tests made at the company's Beaver Falls factory, as a result of which they have been able to fix definitely the heat losses from various sizes of pipe, both covered and uncovered. These losses are also given in B.t.u., per lineal foot, per degree difference in temperature, for twenty-four hours. There are also included tables which show in a general way the most economical thicknesses of Nonpareil high pressure covering to use, based on different steam costs. A complete set of specifications covering the correct installation of these various thicknesses is also included in this very interesting and well-illustrated booklet.

Lighting the Panama Canal

The United States is largely indebted to the efforts of Swedish engineers for an economical means of lighting the Panama Canal. In Sweden the reefs and narrow inlets are a menace to skippers and fishermen, but the expense of engaging lighthouse keepers and providing them with the means of livelihood would be so great that many dangerous points had necessarily to be left unguarded. That resulted in Gustaf Dalen creating the self-tending lamp, which affords a practical and economical means of light. From that was finally evolved the Aga gas accumulator, which contains 100 times its own volume of gas, and is, at the same time, safe and nonexplosive. It can be fixed to burn for a year or even a longer time without personal attention. The Aga flashlight apparatus also makes it possible to give distinctive characteristics to lights, of any desired duration or combination, while another marvel of this economical device is the sunvalve, which extinguishes the light during the day, thus further diminishing gas consumption. It is that type of lamp that has been installed along the Panama Canal.—Eng. and Contracting.

The Stone & Webster Engineering Corporation are distributing a little booklet, entitled "Work Done and Work Doing," which lists the various items of development work handled by this company in the recent past.

Personal

Mr. M. T. Cantell has been appointed municipal engineer of St. Vital, Man.

Mr. R. M. Hannaford, assistant chief engineer of the Montreal Tramways Company, has been elected president of the Canadian Railway Club.

Lieut.-Col. George G. Nasmith, Ph.D., C.M.G., who has rendered valuable service at the front as analyst and in an advisory capacity on sanitary work for the Canadian forces, is to be honored by the University of Toronto at the convocation to be held May 19th, with the honorary degree of LL.D.

Mr. Robert S. Low, of the well-known Ottawa contracting firm, Bate, McCutcheon & Co., has been appointed honorary colonel of the 4th Overseas Pioneer Battalion. Colonel Low was engaged in the construction of Valcartier camp and received great credit for the manner in which he prosecuted that work.

Mr. Stanley H. Frame, A. M. Can. Soc. C. E., has recently received the appointment from the Dominion Government as District Hydrometric Engineer with the Irrigation Branch, Department of the Interior, Calgary. For the past three years he has held the position of assistant to the city engineer of Calgary.

Mr. Augustin Frigon, C.E., has resigned from the firm of Surveyer & Frigon, consulting engineers, Montreal, to become engineering manager of the Canadian Siegwart Beam Co. Mr. Frigon is a graduate of Laval University and for several years has been a member of the Faculty of that university. The firm name of Surveyer & Frigon has been changed to Arthur Surveyer & Co.

Obituary

Lieut. Frank J. Lawson, B.A.Sc., recently with the engineering department of the city of Calgary is dead of wounds received in France. Lieut. Lawson was the only son of the well-known architect F. J. Lawson of Calgary.

Miscellaneous

The opening of the Thorold Engineers' Club took place on the evening of the 4th inst. Chief Engineer Weller of the Welland Canal formally declared the Club open. He referred to the excellent progress made in Thorold in the past three years with its paved streets and many new industries and hoped the good work would continue. Other speakers were Mr. F. H. Keefer, President Cameron and Secretary Clifford.

A union church is to be built at Conquest, Sask., by the Methodists and Presbyterians of that town at a cost of $8,000. The design of the new structure is an economic adaptation of classic style, and its auditorium will have a seating capacity of 250. The contractor is Peter Wick, of Conquest, and the architects are Storey & Van Egmond, of Regina.

Returning from a tour to New York and Philadelphia, Mr. Paul E. Mercier, chief city engineer of Montreal, has issued instructions that asphalt in that city must be laid at not more than $1.90 a yard, as compared with a minimum of $2.14 in previous years. There are about 400,000 square yards to be laid in Montreal this year, and if the work can be done at this figure per yard, the total cost will be $240,000 less than the estimate, which was made on the basis of $2.50 a square yard. Mr. Mercier will also, if he receives the approval of the Board of Control, make improvements in the city's asphalt plant, that will, he declares, save another 10 per cent. on the cost of asphalt at the plant.

Mainly Constructional

East and West—From Coast to Coast

Messrs. Peden & McLaren, architects, 20 St. Alexis St., have removed to 54A Beaver Hall Hill, Montreal.

Mr. L. J. Bigonesse, architect, has removed from 92 Notre Dame Street East, to 60 Notre Dame Street East, Montreal.

In future Montreal will call for public tenders on all work connected with streets and sewers; the city will also tender on the work.

Building activity in the city of Quebec still continues. Fifty-three permits were granted, amounting to $121,495.00, in one week recently.

Thousands of dollars have been expended by Messrs. Kennedy & Sons on the revolutionizing of an old steel plant in Collingwood, Ont., and they have now a staff of over sixty hands working.

During the month of April this year there were thirty-two building permits issued in the city of Woodstock, for the total sum of $25,260.00. This is just about twice the amount for the same period in 1915.

In the city of Galt, Ont., during the month of April there were twenty building permits issued representing a value of $13,210.00. For the year up to the present there have been 27 permits issued amounting to $18,360.00.

Contractors in Brandon, Man., complain that there is unfairness in the letting of contracts by the Dominion Government. They claim that they are not given sufficient time to obtain blank tender forms from Winnipeg and submit their tenders.

The new Rudkins Brass and Iron Co. foundry in Peterboro, Ont., is now in operation, under the managership of Mr. Wm. Rudkins, and is now filling a large number of orders. Additional machinery is to be installed and work will be proceeded with on a much larger scale than at present.

Building permits issued in St. Catherines, Ont., for the month of April show that there is considerable activity in that line. The total value of the permits for that month was $78,775, amongst them being one to the Dominion Food Co., Ltd., for the erection of a factory building at a cost of $14,000.

Thomas Kelly, head of the Winnipeg contracting firm of Thomas Kelly & Sons, has returned to Winnipeg to face charges of theft, receiving money under false pretences, and perjury, having been unsuccessful in his fight in the supreme court of the United States against an order for his extradition to Canada.

A factory bylaw is being submitted to the ratepayers of Port Hope, Ont., whereby Mr. Brandon, the head of a new concern, agrees to establish a manufacturing business in the building which was erected for the International Tool Steel Co., and to put the building in repair and start manufacturing within the first year.

Satisfactory progress is being made with the Toronto-Hamilton highway in the district around Burlington, Ont. The road is now being graded between Burlington and Walker's Crossing. Engineer Baldwin, who is in charge of the work there, says it is probable the road will be completed through the town by the end of June.

Mr. John E. Pearson, architect, Toronto, stated before the Commission appointed at Ottawa to inquire into the cause of the Parliament Buildings fire on February 3, that there was in his opinion no evidence to show that there had been an explosion or anything in the spread of the fire which could not be accounted for by the structure of the building.

There were 38 building permits issued in the city of Vancouver for April 1916, representing a value of $64,605.00, as compared with 86 for April, 1915, representing a value of $31,754.00. The total number of permits issued for the first four months of this year was 125, value $358,350.00, while for the same period last year there were 278 representing a value of $302,791.00.

Western Ontario city engineers have been discussing the advisability of grouping the municipal departments of each town or city in connection with engineering. It seems to be the general belief that these departments could be run more efficiently, were they operated and directed from a central engineering department. Such is the reported opinion expressed by the city engineers of Berlin, Guelph, Stratford and Galt.

The nineteenth annual meeting of the American Society for Testing Materials will be held in the Hotel Traymore, at Atlantic City, June 27 to 30. The first day will be devoted to miscellaneous reports and papers on heat-treatment of steel. Reports on steel and iron, and on tests and testing will be presented the second day. The last two days will be devoted to reports on cement and concrete, ceramics and road materials, non-ferrous metals, cast iron and miscellaneous material.

Work on the Bloor St. viaduct in the city of Toronto, Ont., is progressing, and the contractors on the Don Valley section, Quinlan & Robertson, have the first 150 foot arch up and half riveted. One of the biggest parts of the work will be the building of the timber false work, into which the concrete will be poured. The contractors for the Rosedale section are further advanced and will be putting down the floors before long . The contractors on both sections are considerably ahead of their time contract with the city.

A contract for the construction of a five storey garage to be erected at the corner of Laurier Ave. and Durocher St., Outremont, has been let by Mr. Wilfred Duquette to L. A. Ott & Co., 611 New Birks Building, Montreal. The building will be 86 x 50, and 47 feet high. It will be constructed of reinforced concrete, faced with brick. The mushroom system will be used. The floors will be of reinforced concrete. A freight elevator to convey the automobiles, either to the basement or the upper storeys will be installed. The architect is Mr. S. Frappier, of Montreal.

Preliminary work for foundations of a big C. P. R. electric crane on the company's wharf at Vancouver has just been started. The crane, which is built to the design, and will be installed under the supervision, of Mr. H. Rindall, the C. P. R. chief engineer at Vancouver, will be of the upright mast and swinging boom type with a 50 ton capacity. The mast will be 50 feet high and the boom will be 100 feet long, both being of steel lattice. The Cotton Company, Limited, were awarded the contract for the foundations, in which there will be used about 250 yards of concrete.

The Toronto Harbor Commission have awarded the contracts for the construction of a concrete harbor-head wall and cribs, between Bathurst and Brock streets to two local firms, the Robert Weddell Company and the Dredging and Dock Company. The former company is to handle section 1 of the work, which includes a new harbor-head wall from the west end of the present Government wall to the west boundary of Spadina Avenue, and the latter company have the contract for section 2, consisting of construction work from Spadina Ave. to a point between Spadina Ave. and Peter St.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks Sewerage and Roadways

Fernie, B.C.
The City Council are having plans prepared for about two miles of sewer in the Annex. Engineer, William J. Ramsey. Approximate cost, $14,000.

Ingersoll, Ont.
The Town Council propose to lay a quantity of tarvia pavement on concrete base. Clerk, W. R. Smith.

Kenogami Township, Que.
The Township Council propose to expend $6,000 on roads during the season. Secretary, T. L. Potvin, St. Cyriac, Que.

Moncton, N.B.
The City Engineer, J. Edington, will receive tenders until noon, May 25th, for the construction of about 14,200 square yards of pavement, either creosoted wood block, bitulithic asphalt or reinforced concrete.

Quebec, Que.
The Ciay Council propose to call for tenders on the construction of pavements and sidewalks and the supply of an asphalt plant. Engineer, W. D. Baillairge.

St. Lambert, Que.
Tenders on the construction of concrete pavement on Waterman and Bridge Streets, will be received until noon, May 22nd, by the Town Secretary, James R. Beatty. Engineer, E. Denkwater.

Toronto, Ont.
The Board of Control will receive tenders until May 23rd for a quantity of sewers, asphalt and brick block pavement, concrete curb and grading. Plans at office of the Works Wepartment.

Usborne Township, Ont.
Tenders will be received until 10 a.m., June 23rd, for the construction of the Bock Creek Drain, estimated to cost $7,468. Plans and specifications at office of the Township Clerk. Francis Morley, R. R. No. 1, Granton.

Wainfleet Township Ont.
The Township Clerk, J. Henderson, Marshville, Ont., will receive tenders until May 27th for the construction of a number of drains.

CONTRACTS AWARDED

Berlin, Ont.
The contract for laying a concrete paveemnt on Queen Street, has been awarded by the City Council to E. J. Holland, Ingersoll, Ont.

Edmonton, Alta.
The City Council have awarded a contract for the construction of about 75,000 feet of sidewalk to D. R. Fraser Company, 10149-97th Street.

Lanoraie, Que.
The Municipal Council have let a contract for roadwork to Stack & Leger, c/o the Secretary, L. J. Desrosiers. Approximate cost, $9,000.

Metcalfe Township, Ont.
The contract for the construction of the Ward Drain has been let by the Township Council to G. Brooks, c/o. the Clerk, Harry Thompson R. R. No. 2, Kerwood.

Sudbury, Ont.
The Town Council have awarded the contract for construction of about 1,800 square yards of bitulithic pavement to the Warren Bituminous Paving Company, Ltd., McKinnon Building, Toronto, at $2.65 per yard.

Public Buildings, Churches and Schools

Beamsville, Ont.
W. W. Lachance, 157 Main Street, Hamilton, has been appointed Architect for the proposed High School. Approximate cost, $20,000.

Beeton, Ont.
The Public School Board are considering the erection of a school at an approximate cost of $20,000. Architect not yet appointed.

John Wilson, Collingwood, has been appointed Architect for the proposed school. Tenders will be called shortly for the erection of a four-roomed brick building.

Dominion City, Man.
Tenders on the erection of a school will be received until May 22nd. Architect, F. R. Evans, 901 Confederation Life Building, Winnipeg. Steel, concrete, brick and Tyndal stone construction. Approximate cost, $20,000.

Dundurn, Sask.
R. M. Thompson, Architect, Masonic Temple, Saskatoon, is preparing plans of a school, estiamted to cost $12,000. Brick and concrete construction.

Fredericton, N.B.
Tenders will be called early next month for the erection of a Sunday School for St. Paul's Presbyterian Church. Architect, G. W. Kramer, 1 Madison Avenue, New York. Approximate cost, $30,000.

Montreal, Que.
The Roman Catholic School Board propose to build a school at Longue Pointe and tenders will be called. Architect, H. Bergeron, Longue Pointe. Brick and stone construction.

The Roman Catholic School Commissioners are having plans prepared for a school to be built in Notre Dame de Grace Parish. Architects, Audet & Charbonneau, 364 Dorchester Street.

Quebec, Que.
Private tenders for the erection of a chapel for the Patronage Laval will be called by the Architect, O. Beaule, 19 d'Aguillon Street. The contract previously reported awarded to J. Chevalier was for excavation only.

Rossland, B.C.
The School Board propose to build a school at an approximate cost of $50,000, of which sum $30,000 has been included in the estimates of the Provincial Government. Secretary to the Board, J. A. McLeod.

St. Andre Avellin, Que.
Tenders on the erection of a convent for the Sisters of Providence are being received by M. le Cure Belanger and the Architect, H. Bergeron, Longue Pointe, Que. Stone and concrete construction.

St. Jean de Dieu, Que.
The Corporation St. Jean de Dieu contemplate the erection of an addition to the Asylum, but tenders will not be called for some time. Stone and concrete construction. Approximate cost, $250,000.

St. Louis de Pintender, Que.
Plans are being prepared by L. Auger, 39 St. Jean Street, Quebec, for repairs to the Parish Church, estimated to cost $15,000. Work includes construction of galleries and painting.

Toronto, Ont
Gordon & Helliwell, Architects, Confederation Life Building, have prepared sketch plans of a hospital for the Women's College Hospital and Dispensary. Estimated cost, $125,000. Secretary, Miss J. F. Anderson, 55 Castle Frank Road.

Weldon, Sask.
Tenders are now being received for the erection of a four-roomed brick school, estimated cost $16,000. Architect, William Knox, 16 Tenth Street W., Prince Albert.

CONTRACTS AWARDED

Basswood, Man.
The general contract for the erection of a school has been awarded to Worswick Brothers, 125 Hart Avenue, Winnipeg. Approximate cost, $14,000.

Conquest, Sask.
The general contract for the erection of a Union Church has been awarded to Peter Wick, c/o. the Architects, Storey & Van Egmond, 1013 McCallum Hill Block, Regina. Approximate cost, $8,000.

Eastview, Ont.
The following contracts have been let in connection with the erection of a school: Steel work, Dominion Bridge Company, Sparks Street; plastering, Murphy & Morrow, 139 Waverley Street; painting, Higman & Son, 176 Rideau Street; electrical work, Charles Presby, 138 Irving Street

Farnham, Que.
The contract for electrical work in connection with the High School now in course of erection for the Protestant Board of School Commissioners, has been let to the Electrical Repair & Supply Company, Sherbrooke.

Finch, Ont.
The general contract for the erection of a school for the School Board of Section No. 3 has been awarded to Stafford R. Rudd, Madawaska Street, Arnprior. E stimater cost, $12,000.

Leclercville,, Que.
Work is progressing on the erection of a school, estimated to cost $8,000. General contractor, Ernest d'Aigle, Ste. Emelie de Lothbiniere.

Montreal, Que.
In connection with the erection of a Presbytery for Ste. Catharine Parish, the painting contract has been awarded to Joseph Guy, 325 Workman Street.

Port Colborne, Ont.
The general contract for the erection of a church for the St. James Congregation has been awarded to Ryan & Gardner, Welland, and work will start shortly. Approximate cost, $24,000. Stone and concrete construction.

Sherbrooke, Que.
The contract for roofing in connection with St. Michael's Cathedral, has been awarded to P. M. Hoadley & Company, 284 Beaver Hall Hill, Montreal.

Business Buildings and Industrial Plants

Brantford, Ont.
P. H. Secord & Sons, Ltd., 133 Nelson Street, are building a storage building, estimated to cost $4,000. Brick and concrete construction.

Hamilton, Ont.
The Grasselli Chemical Company propose to build an addition to their premises on Burlington Street, and have prepared plans. Frame and corrugated iron construction. Estimated cost, $18,000.

Mont Joli, Que.
Pierre Levesque, 115 St. John Street, Quebec, is preparing plans for premises to be built for La Banque Nationale, 75 St. Pierre Street, Quebec. Stone and brick construction. Approximate cost, $15,000.

Montreal, Que.
Antoine Dinardo, 590 St. Timothe Street, has commenced the erection of a garage and flats, estimated to cost $5,500. Brick and concrete construction.

Work has been started by Narcisse Bellehumeur, 12 Montgomery Street, on the erection of a store and flats, estimated to cost $3,500. Brick and concrete construction.

The City Council have started work by day labor on the erection of a temporary Fire Station on Bickerdike Street. Brick and concrete construction. Estimated cost, $4,000.

Turner Bros., Ltd., 34 St. Peter Street, are about to start work on a warehouse, estimated to cost $18,000. Frame and concrete construction.

North Battleford, Sask.
Plans have been prepared for an addition to the premises of Pickel & Johnstone, Main Street. Estimated cost, $7,000.

Ottawa, Ont.
Millson & Burgess, Union Bank Building, are preparing plans of a Club House for the Knights of Columbus, to cost about $25,000. Tenders will be called shortly. Brick and concrete construction.

Charles Joyce, 883 Somerset Street, will shortly call for tenders on the smaller trades in connection with the stores and apartments which he is building.

Port Glasgow, Ont.
Galbraith & Dromgole, Rodney, are considering the rebuilding of fish houses recently destroyed by fire. Estimated cost, $3,000.

Quebec, Que.
Plans have been prepared by A. L. Robitaille, Lindsay Building, St. John Street, for the conversion of a building into a bank for Lacaisse d'Eco. Nomie de Quebec. Estimated cost, $8,000. Tenders will be called shortly.

St. John, N.B.
The sum of $500,000 for rebuilding the elevator owned by the Intercolonial Railway has been included in the supplementary estimates.

St. Thomas, Ont.
Arthur Harbour, East and Talbot Streets, is considering extensive interior alterations to a business blcok, estimated to cost $10,000. Architect not yet appointed.

Sudbury, Ont.
The Town Council are having plans prepared for a power station to be built on David Street at an approximate cost of $15,000. Architect, Victor L. Morgan, Wilson-Greenwood Block. Brick, concrete and steel construction.

Toronto, Ont.
H. T. LePage, 1152 Dundas Street, is building a factory, estimated to cost $25,000. Steel and brick construction.

Winnipeg, Man.
The Breen Motor Company, Broadway and Sherbooke Street, propose to build a garage at an approximate cost of $15,000. Brick and concrete construction.

Woodman & Carey, Lindsay Building, have prepared plans of a publishing house for the Stovel Company. Estimated cost, $225,000. Brick and limestone construction.

CONTRACTS AWARDED

Barriefield, Ont.
The contract for construction of frame buildings at the Camp has been let by the Department of Militia to the Kingston Construction Company, Brock Street, Kingston. Approximate cost, $12,000.

Belleville, Ont.
The general contract for the erection of a storehouse for W. S. Cook,209½ Front Street,has been awarded to R. P. White, 46 Grove Street, and work has started. Stone and brick construction. Approximate cost $3,000.

Brandon, Man.
The Imperial Oil Company have let the contract for the construction of a warehouse and tanks to A. E. Bullock, 202 13th Street. Frame and reinforced concrete construction. Approximate cost, $10,000.

The general contract for the erection of five stores for G. R. Coldwell, 122 18th Street, has been let to F. C. Lissaman, 812 11th Street. Brick construction. Approximate cost, $10,000.

The general contract for the erection of a store for Doig, Rankin & Robertson, has been awarded to A. E. Bullock, 202 13th Street. Stone, concrete and brick construction. Estimated cost, $39,000.

A. E. Bullock has been awarded the general contract for an addition to the premises of the Crescent Creamery Company, 1321 Rosser Street. Estimated cost, $4,000. Brick veneer construction.

Brantford, Ont.
In connection with the erection of a storage building for the American Radiator Company, the contract for installation of a sprinkler system has been awarded to the Canadian General Fire Extinguisher Company Ytd., 1200 Dundas Street, Toronto.

Dundas, Ont.
The contract for masonry and carpentry required in the erection of a store and residence for H. Cohen, King Street, has been let to the Dickson Building Company, King Street, heating and plumbing to Louis Gies, King Street; electrical work to W. G. Laird, and store front contract to Kawneer Manufacturing Company, Guelph and Toronto.

Galt, Ont.
The contract for steel work required in the erection of additions to the plant of the Goldie & McCulloch Company Ltd., has been let to the Hamilton Bridge Works Company, Ltd., Bay Street N., Hamilton, and the remainder of the work to P. H. Secord & Sons, Ltd., 133 Nelson Street, Brantford. Work includes an addition to the power plant at the North Works, a power plant at the South Works, and additions to the office at the South Works. Approximate total cost $55,000.

Hamilton, Ont.
The contract for steel work in connection with the stable now being built by George Hill, 21 Vine Street, has been awarded to the Hamilton Steel Construction Company, Lottridge Street. Roofing by owner.

Montreal, Que.
The general contract for an addition to the premises of C. H. Johnson & Sons, Ltd., 8 Dagenais Street, has been let to A. F. Byers & Company, 340 University Street, and work has been started. Approximate cost, $4,000.

The contract for roofing in connection with tre garage now being built by Henry Morgan & Company, 15 Beaver Hall Hill, has been let to George W. Reed & Company, Ltd., 37 St. Antoine Street.

The contract for marble work required in the erection of an exchange for the Bell Telephone Company has been let to the Smith Marble & Construction Co., Ltd., 145 Van Horne Street.

The general contract for the erection of business premises for Verret, Stewart & Company, Ltd., 12 Port Street, has been let to M. B. Shaw, 151 Metcalfe Street. Approximate cost, $15,000. Sub-tenders on most trades will be received by the general contractor.

Ottawa Ont.
In connection with the gymnasium now being built for the Y. W. C. A., Hintonburg Branch, the contract for supply of Milton Buff Brick has been let to C. Watt, 182 Queen Street; terra cotta tile to D. J. McKenzie, Queen Street; heating and plumbing to Coldrey & Chapman, 348 Rideau Street, and carpentry to the general contractor.

Perth, Ont.
The general contract for the erection of a garage for James & Reid, Gore Street, has been awarded to W. J. Rabb, Wilson Street. Approximate cost $5,000.

Quebec, Que.
The contract for steel work required in the erection of a freight shed and grain galleries for the Quebec Harbour Commissioners has been awarded to the Eastern Canada Steel & Iron Works, Ltd., St. Malo, and the roofing to E. Falardeau, 143 Dorchester Street.

The contract for roofing in connection with the theatre now in course of erection at St. Valier and Carillon Streets, has been awarded to E. Falardeau, 143 Dorchester Street.

Work has been started on the conversion of a store into a hall for Rev. I. O. P. Cloutier, 350 St. Joseph Street. The general contract has been let to A. Deslauriers, 400 St. Francois Street. Approximate cost, $3,000.

Regina, Sask.
The general contract for the erection of a warehouse for the Canadian Consolidated Rubber Company, Ltd., has been let to Pool & Emery, Smith and Twelfth Streets. Approximate cost, $24,000. Fireproof construction.

St. Catharines, Ont.
The general contract for the erection of a factory on Ontario Street for the McKinnon Dash & Hardware Company, has been let to Sherwood & Sherwood, Mail Building, Toronto. Approximate cost, $75,000. Reinforced concrete construction.

In connection with the erection of a factory for the Marathon Tire & Rubber Company, Ltd., 45 King Street, the contract for installation of a sprinkler system has been let to T. H. Higginson, Ltd., 70 Lombard Street, Toronto.

St. George Que.
Berube & Frere have commenced the erection of a store for Octave Papillon, estimated to cost $4,000. Frame and brick construction.

Stamford ownship, Ont.
The contract for roofing required in the erection of a plant for the American Cyanamid Company, has been let to the Keystone Fireproofing Company of Canada, Ltd., 304 University Street, Montreal.

Sudbury, Ont.
In connection with the business block now in course of erection for F. M. Stafford, Durham Street, the contract for steel has been let to Hepburn & Disher Ltd., 18 Van Horne Street, Toronto. Previous report in error.

Toronto, Ont.
The following contracts have been let for the erection of an office building and gateway for the Toronto General Burying Ground: masonry, C. W. Wood & Sons, 613 Manning Avenue; carpentry, S. B. Bagshaw, 477A West Marion Street; roofing, R. Rennie & Son, 198 Dupont Street; plumbing and heating, Fiddes & Hogarth, Ltd., 122 King Street E.; wiring, H. Alexander 98 Bay Street; plastering, Duckworth Brothers, 119 Huron Street; marble and tile, Italian Mosaic & Marble Company, College Street; painting, F. G. Roberts & Company, Ltd., 106 Wells Street. Approximate cost, $10,000.

The general contract for the construction of a work shop for A. R. Clarke & Company, 633 Eastern Avenue, has been awarded to J. D. Young & Son, 835 College Street. Approximate cost, $10,000

In connection witr the office building in course of erection for the Imperial Oil Company, the contract for painting has been let to the Barker Painting Company, 355 West 26th Street, New York City.

W. Hughes, 59 Amroth Avenue, has let the general contract for the erection of a store and residence to A. Binns, 59 Amroth Avenue. Smaller trades will be sub-let by the general contractor. Estimated cost, $4,500.

Page & Company, Queen's Park, are building an addition to the machine shop of J. T. Hepburn, Ltd., 18 Van Horne Street. Brick and steel construction. Approximate cost $3,500.

The Toronto Electric Commissioners, 226 Yonge Street, have let the following contracts for an addition to the sub-station at Ruskin and Edwin Streets: masonry, A. J. Penberthy, 292 Booth Avenue; plumbing, Purdy Mansell, Ltd., 63 Albert Street; steel, McGregor & McIntyre, 1139 Shaw Street; ornamental iron W. D. Beath & Son, Ltd., 20 Cooper Avenue; roofing, A. Matthews, Ltd., 235 Adelaide Street W.; painting, C. W. Landon, 569 College Street.

Westboro, Ont.
In connection with the store and residence now being built for Mrs. O'Neil, Highland Park the electrical work has been awarded to the Rideau Electric Construction Company, 128 Bank Street, Ottawa. Brick veneer and concrete construction. Estimated cost, $3,000.

Whitebread, Ont.
The general contract for the erection of a barn for Hugh Turner has been let to Philip Mills, and work has started. Steel construction. Approximate cost, $3,000.

Winnipeg, Man.
The contract for steel work required in the erection of a warehouse for the T. Eaton Company, has been let to Manitoba Bridge & Iron Works Logan Avenue W. Heating and plumbing by owners.

Residences

Halifax, N.S.
A Cobb, Architect, Tramway Building, is preparing plans for alterations to a residence for J. R. Murphy, 197 South Park Street. Frame and concrete construction. Estimated cost, $6,000.

Hensall, Ont.
James W. Johnston proposes to build a residence, at an approximate cost of $3,500 and will prepare plans.

Leamington, Ont.
Roland Dunphy is considering the erection of a residence, at an approximate cost of $3,000, and will prepare plans.

Montreal, Que.
A. Germain, 101 Rachel Street E., has started work on the erection of a residence, estimated to cost $5,000.

Work on the erection of a residence has been started by J. B. Daoust, 468 Prudh'omme Street. Brick and concrete construction. Estimated cost, $5,600.

J. Pariseau, 299 Regent Street, is building flats on Harvard Street, estimated to cost $4,000. Brick veneer construction.

Ottawa, Ont.
Plans rave been prepared for a block of apartments to be built for W. Shenkman, 360 Friel Street, at an approximate cost of $20,000. Owner is receiving prices on plastering, painting, heating, plumbing and electrical work.

J. H. Putman, 206 Rideau Terrace, has prepared plans for residences to be built at an approximate cost of $7,000. Double brick veneer and stone construction.

W. H. Lee, 36 Barton Street, has commenced the erection of a residence on Wilton Crescent, and will let contracts for smaller trades. Estimated cost, $4,500. Stucco and brick veneer construction.

The Capital Construction Ltd., 245 Fourth Avenue, are building a residence on Carlyle Street, estimated to cost $4,000. Brick veneer and stucco construction.

Quebec, Que.
Wilfred Legard, St. Foye Street intends to build a residence, at an approximate cost of $7,000. Brick and concrete construction.

Leon Lessard, 307 Morin Street has commenced tre erection of a residence, estimated to cost $3,000. Brick and frame construction.

Renfrew, Ont.
Donald Campbell, 6 Driveway West, Ottawa, has started work on three residences, to cost about $2,000 each. Frame and concrete construction.

Ridgetown, Ont.
Watson & Taylor have commenced the erection of a residence on Erie Street estimated to cost $3,000. Frame and white brick construction.

Sudbury, Ont.
The J. B. Laberge Lumber Company, Notre Dame Street, have commenced the erection of a residence on Larch Street, estimated to cost $9,000 Brick and concrete construction.

The Day Building Company, Elm Street, propose to build a pair of semi-detached residences on Baker Street, and have had plans prepared. Estimated cost $7,000. Brick veneer and stone construction.

Sydney, N.S.
The J. E. Burchell Company, Ltd., 209 Charlotte Street, will let contracts for the erection of eight residences in various parts of the city. Approximate cost, $2,000 each

M. R. Chappell, Main Street, has been appointed Architect for the residence to be built for J. F MacKenzie, Reserve Mines. Approximate cost $3,700.

Toronto, Ont.
D C. Cotton, Architect, 54 Adelaide Street E., has prepared plans for a pair

of residences to be built on Bathurst Street. Brick construction. Approximate cost, $5,000.

D. Gould, 1197 St. Clair Avenue, has started work on a pair of residences, estimated to cost $4 000. Smaller trades will be let. Brick construction.

Work has been started by J. W. Clare, 1759 Dufferin Street, on the erection of a pair of residences, estimated to cost $6,500. Brick construction. Smaller trades will be let.

J. Price, 134 Lee Avenue, has started work on a residence, estimated to cost $3,500 and will let smaller trades. Brick construction.

Work on the erection of a duplex residence has been commenced by C. H. Pickering, 200 Rashton Road. Brick construction. Approximate cost, $8,000.

H. McLean, 77 Seventh Street, has commenced the erection ot a pair of residences, to cost about $3,500. Brick construction. Smaller trades will be let.

Vermont, Ont.
.. J. P. MacLaren, 104 Sparks Street Ottawa, is preparing plans for remodelling a large colonial residence. Estimated cost, $4,000.

Watford, Ont.
S. J. Saunders, John Street, is considering the erection of a residence. Approximate cost, $3,000.

Welland, Ont.
S. L. Lambert 56 Main Street N., has started work on a residence on Merritt Street, estimated to cost $5,000. Brick and concrete construction.

CONTRACTS AWARDED.

Belleville, Ont.
The general contract for the erection of two residences for M. Doyle, Grove Street, has been let to Thomas Finnegan, 86 Chatham Street. Approximate cost, $3,300.

Brantford, Ont.
John McGraw & Son, Temple Building have been awarded the general contract for the erection of a residence for J. H. Young, 86 Colborne Street. Brick, stone and concrete construction. Estimated cost, $3,000.

The contract for electrical work in connection with the residence now being built for E. L. Goold, 103 Darling Street, has been let to F. Webster, 211 Colborne Street.

Hamilton, Ont.
The general contract, masonry carpentry and roofing, required in alterations to a residence for F. Steedman, Bay Street N., have been let to William Yate, Jr., 24 Leeming Street. Estimated cost, $3,000.

Montreal, Que.
The general contract for the erection of a residence for Mrs. G. Walker, 154 Marlowe Street has been awarded to H. W. Creed, 154 Marlowe Street. Estimated cost, $6,000.

The contract for brick work and masonry required in connection with the flats now being built by Daniel Blay, 302 Clifton Avenue, has been let to Henry Paul, Ville St. Pierre Street, and the roofing to Jules Leduc, 758 Notre Dame Street W. Carpentry by owner.

Oshawa Ont.
Walter Stacey has let the general contract for the erection of a bungalow to Charles N. Stacey and John Loveday. Estimated cost, $3,000. Brick veneer construction.

The general contract for the erection of a residence for R. S. McLaughlin has been awarded to the Dickie Construction Company, Ltd., Ryrie Building, Toronto. Approximate cost, $200,000. Architects, Darling & Pearson 2 Leader Lane, Toronto.

Ottawa, Ont.
In connection with the erection of a residence for C. Sutherland, 460 McLeod Street, the brick work has been let to H. Spence, Hintonburg Street, carpentry to George Eaman & Sons, Catherine Street, and heating and plumbing to McKinley & Northwood, 56 Rideau Street.

In connection with the erection of a residence for C. Sutherland 460 McLeod Street, the brick work has been let to H. Spence, Hintonburg Street; carpentry to George Eaman & Sons, Catherine Street, and heating and plumbing to McKinley & Northwood, 56 Rideau Street.

The general contract for the erection of a residence for A. Chabot, 141 George Street, has been let to A. D. Hudon, Clargestown, near Ottawa. Brick veneer and concrete construction. Approximate cost $5,000.

The general contract for the erection of apartments for F. Valequette, 5 McKay Street, has been let to A. D. Hudon, Clarkestown. Brick veneer and concrete construction. Estimated cost, $7,000.

A. H. Jarvis, 157 Bank Street, has let the general contract for an addition to apartments on McLaren Street to George Eaman & Sons, 8 Chamberlain Street. Brick veneer stone and concrete construction. Approximate cost, $8,500.

The general contract for the erection of a residence for Mrs. Symillie has been let to W. H. Craig, 245 Fourth Avenue. Brick veneer and stucco construction. Estimated cost, $5,000.

The general contract for the erection of residences for Father Myraud, Anglesea Square, has been awarded to E. Eamand, 14 Nelson Street. Double brick veneer and stone construction. Approximate cost, $8,000.

The contract for plastering required in connection with the apartments now being built by J. B. Younghusband, 6 Spruce Street, has been let to C. H. Patterson, 873 Somerset Street, and the electrical work to P. Ackroyd, 416 Bank Street. Carpentry and painting by owner.

Pelham Township, Ont.
The general contract for the erection of a residence for Elmer Lane, Ridgeville, has been awarded to Louis Haney, Fenwick, and work has started. Frame and concrete construction. Estimated cost, $3 000.

W. Grisdale, Thorold, has commenced the erection of a residence for H. G. Self, Fonthill. Brick and stone construction. Estimated cost, $3,500.

Quebec, Que.
In connection with the erection of a residence for H. M. Cote, 631 St. John Street, the contract for roofing has been let to O. Barbeau, 154 Franklin Street, and the heating, plumbing and electrical work to J. Lafrance, 21 Plessis Street.

Sault Ste. Marie, Ont.
The general contract for the erection of a residence for W. H. Ewing, Albert Street, has been awarded to A. C. McLeod & Sons, 61 Dufferin Street. Approximate cost, $6,000.

St. Thomas, Ont.
The general contract for the erection of a residence for Mrs. C. O. Stanley, Hincks and Wellington Streets has been let to Albert Morriss, 68 Elysian Street. Pressed brick and concrete construction. Estimated cost, $4,000.

Toronto, Ont.
In connection with the erection of a residence for Harton Walker, 20 Toronto Street, the contract for plumbing and heating has been let to R. Ross, 1349 Queen Street W., plastering to J. Boyce & Son, 247 Grace Street, and wiring to B. C. Taylor, 33 Marchmount Road.

The general and carpentry contracts for the erection of a residence for J. Skelton, Room 36, 33 Richmond Street W., have been awarded to H. T. Belfry, 92 Wheeler Avenue. Approximate cost, $6,500. Other trades will also be let.

Welland, Ont.
The general contract for the erection of a residence for Frank Adley, 15 Avenue Place, has been let to C. Timms. Brick and concrete construction. Approximate cost, $3,200.

Westboro, Ont.
Work is progressing on the erection of a residence for Donald Fraser, O'Connor Street Ottawa. The contract for electrical work has been let to P. Askroyd, 416 Bank Street, Ottawa. Approximate cost, $3,000.

F. Hill, Richmond Road, is building a residence on Springfield Avenue, and has let the electrical work to W. D. Jeffrey, Woodroofe. Brick veneer and stone construction. Approximate cost, $3 500.

Westmount, Que.
In connection with the residences now being erected on Sherbrooke Street by Charles Fyfe, 176 Mance Street, Montreal, the contract for brick work has been let to G. M. Martin Company, Ltd., 399 Decarie Boulevard, and the heating and plumbing to J. B. Staton, 5410 Sherbrooke Street W.

Power Plants, Electricity and Telephones

Saskatchewan Province.
The following Rural Telephone Companies have been empowered to borrow money for the construction of their systems: Conger R.T.C., $11,500, Secretary, E. J. Davis, Traux; Glenavon R.T.C., $2,400, S. George, Glenavon; Edge Hill R.T.C., $6 800, Edwin Johnson, Parkbeg; Davin R.T.C., $9,500, J. F. Parsons, Davin; Kalamazoo R.T.C., $8,500, E. C. Crystal, Mortlach; Alpha R.T.C., $5,000, W. H. McArthur, Montmartre.

Weyburn, Sask.
Commissioner George V. Reid will receive tenders until 5 p.m., June 1st, for the supply of one 500-k.w. steam turbine, generator, switchboard and auxiliaries.

CONTRACTS AWARDED

St. Francois de Beauce, Que.
The contract for the construction of the proposed system of the Beaceville Telephone Company has been awarded to Arthur Martel. Approximate cost, $10,000.

Fires

Blackville, N.B.
Residence of Stephen Brophy completely destroyed.

Flesherton, Ont.
Grain elevator owned by J. & W. Boyd. Loss, $5,000.

Montmagny, Que.
Premises of the General Car Machinery Company totally destroyed. President, Charles A. Paquet, Quebec.

Port Arthur Ont.
Ogden Hotel, owned by Frank Clifton. Loss, $10,000.

Simcoe, Ont.
Factory of the Lampkin Pump Works totally destroyed.

Miscellaneous

Edmonton, Alta.
The City Engineer, A. Haddow, has recommended the construction of a levee around the power house, estimated to cost $21,000.

Port Stanley, Ont.
The Department of Public Works Ottawa, have included in their supplementary estimates the sum of $100,000 for repairs to the harbour.

Toronto, Ont.
The Dickie Construction Company, Ltd., Ryrie Building, are open to receive sub-tenders on all trades required in the erection of a mill for Horion Brothers, Lindsay, and a Polish Roman Catholic Church at Berlin.

CONTRACTS AWARDED

London, Ont.
The City Council have awarded the contract for the supply of a street flusher to George Heaman, 749 Simcoe Street at $4,950.

Toronto, Ont.
The Toronto Harbour Commissioners have awarded the following contracts for construction of crib work and concrete wall: Section No. 1, R. Weddell & Company, foot of Spadina Avenue; section 2, Dredging & Dock Company, 307 Logan Avenue. Approximate total cost, $300,000.

Late News Items

Beloeil, Que.
The General contract for the erection of a school has been awarded by the School Board to Alphonse Hubert, Beloeil. Approximate cost, $10,850.

Fort William, Ont.
The general contract for the remodelling of a business block for I. C. Murray has been awarded to E. G. Penniman, Graham and Horne Block, the plumbing to Barnes Company, Cameron Street, and heating to the Varlow Foundry Limited, Syndicate Avenue. Approximate cost, $12,000.

Ottawa, Ont.
The Board of Control will receive tenders until May 30th for the construction of a tarvia pavement on Russell Avenue. Engineer, F. C. Askwith. Estimated cost, $9,000.

Charles Joyce, 883 Somerset Street, is receiving tenders on the smaller trades required in connection with the stores and apartments which he is building. Closing date, May 19th.

Sarnia, Ont.
Bulk or separate tenders on the erection of a school on Lochiel Street will be received until June 1st by the Chairman of the Board of Education. Plans and specifications at offices of the Board of Trade, City Hall, and with the Architects, S. B. Coon & Son, Ryrie Building, Toronto. Estimated cost, $55,000.

Ste. Therese, Que.
The contract for plumbing required in the erection of a convent for the Rev. Sisters of the Congregation Notre Dame has been awarded to Michel Chouinard, Maisonneuve. Plastering and painting will be sub-let by the general contractors.

Stratford, Ont.
The Congregation of Central Methodist Church have appointed a Committee to make arrangements for alterations to the building, estimated to cost $15,000. J. A. Davidson, 208 Church Street, is Chairman.

Tavistock, Ont.
The contract for masonry required in connection with the erection of the Carnegie Library has been awarded to John Piehl, and painting to Henry Schlitt.

Toronto, Ont.
The Board of Control have let the general contract for the erection of a Women's Cottage at the Industrial Farm, Concord, to John McLeod & Company, 110 Church Street, at $53,000. Brick construction.

The following contracts have been let in connection with the erection of a garage at Yonge and Baxter Streets for W. J. Fennell, 6 De Lisle Street:—carpentry, William Clarke; roofing, G. T. Jackson, 82 River Street; plumbing and heating, J. R. Seager, 799 College St.; wiring, Harris & Marson, 81a Parkway Avenue.

Woodstock, Ont.
The general contract for alterations to the premises of the E. J. Coles Company, 493 Dundas Street, has been awarded to A. J. McKinney, Ingersol Avenue. Approximate cost, $10,500.

Pipe Lengths on Light Bents Hold Mains Down During Tests

Water mains under test have to be kept from pulling apart longitudinally, rising vertically and creeping sidewise. The longitudinal movement is pereventable by the same bracing that holds the cap on. Sidewise movement can be easily prevented by blocking and wedging the pipe in between the opposite banks, which are usually quite close.

To prevent the vertical movement some contractors backfill high over the normal top of the trench. This method does not serve well if the test pressure is high, and, in any case, is wasteful, as the trench usually has to be re-excavated for quite a length to permit the removal of the cap and the continuance of the line. Another way is to load extra pipe lengths on the main under test, using supports erected according to the individual judgment of the handy-man or calker who happens to be doing the work.

A systematizing of the latter method —or an adaptation of the two if the test pressure is especially high—will save the water main contractor money if there are sufficient test sections on his job to warrant it.

A supporting platform can be made by sawing two 4 x 12 inch planks as templates, cross-connecting them securely and nailing a 2 x 12 inch plank on them. Two of these platforms should be provided, one for each end of the pipe. If it is intended to leave the main under test uncovered for more than one length, enough should be provided to carry back as far as the main has a tendency to rise. Light bents should be constructed sufficiently strong to sustain the load that may be put upon them, and of a height determined by the average depth of trench.

The templates should be set down on the main and the bents placed on them and secured by plank straps lightly spiked. Squared timbers are then laid on top of the bents parallel to the trench, and skids resting on the bank on each side placed on the timbers. Extra pipes can then be rolled onto the skids, using as many as are needed to obtain the desired weight, and wedged in place. The whole weight does not need necessarily to rest directly on the pipe—in fact, it is desirable that it should not. It should rest mainly on the banks, but the bents should be fitted in so snugly that to rise at all under the pressure the main would have to lift the entire weight. In the case of an exceptional trench depth the height of the tops of the bents could be adjusted to suit by blocking up. If when actually under pressure the main shows a tendency to rise despite the weight of all the pipes that can find a place on the skids, dirt to the amount required to overcome the tendency can be shoveled on it. This will occur only under a very heavy test pressure.

The advantage of this method lies in the fact that the greater part of the work is done at one time and not repeated. Once the templates and bents are built it is simply a case of blocking to suit. The method is reduced to a rule-of-thumb process. The units will be light enough to be handled and hauled from point to point without difficulty, and there need be no timber butchering. Another advantage is that the contractor need not waste labor placing a weight that is more than is required. He can roll on such pipe as he thinks are necessary. A water main, under test, does not jump suddenly out of a trench. It slides up slowly. If the man observing notices a tendency to do so he can have more weight rolled on as needed.

Treated Ties Save Growing Trees

Of the 3,000,000 cross ties used every year by the Chicago, Burlington & Quincy Railroad for replacement purposes over 70 per cent. are treated with a preservative. According to J. H. Waterman, superintendent of the railroad's wood-preserving plant at Galesburg, Ill., the millions of treated ties in their tracks now last from twelve to twenty years, whereas untreated they last on an average of eight years. In each of the twenty divisions of the Burlington system there are tracks for experimental purposes containing 26,000 treated ties of different species, which are all carefully inspected at least once a year for the actual results of treatment as shown by the service test.

Tenders and For Sale Department

To Contractors

Sealed bids for all trades required in making alterations and additions to a residence in Elm Ave., Toronto, will be received up to noon of **Monday, May 22nd, 1916.** Plans and specifications and all particulars may be obtained at the office of the architect.

The lowest or any bid not necessarily accepted.

F. S. BAKER, Architect,
Traders Bank Building,
Toronto, Ont.

20-20

Tenders for Steam Turbine

Sealed tenders will be received up till 5 p.m., **Thursday, June 1st, 1916,** addressed to the City Commissioners, Weyburn, Sask., for the supply and erection of one 500 K.W. Steam Turbine, Generator, Switchboard and Auxiliaries.

All information may be had by applying at the above address.

The lowest or any tender not necessarily accepted.

DR. C. P. MOORE, Mayor.
GEO. V. REED, Commissioner. 20-21

Canadian Pacific Railway Co.

North Toronto Grade Separation

Tenders will be received by the undersigned up to May 31st, 1916, for the purchase and removal of the old Canadian Pacific Railway North Toronto Station Building.

Proposal forms and other information may be obtained at the office of the undersigned, 262 Avenue road, Toronto.

No tender necessarily accepted.

B. RIPLEY,
Engineer of Grade Separation.
19-21

Tenders for Paving Main Street

CITY OF MONCTON, N. B.

Sealed tenders, addressed to the undersigned and marked "Tender for Paving," will be received at the City Engineer's Office, up till 12 o'clock noon, on **Thursday, May the 25th,** for the construction of about 14,200 square yards of pavement (Creosoted Wood Blocks, Bitulithic, Asphalt or Reinforced Concrete), according to plans and specifications which may be seen at the City Engineer's Office, where forms of tender can be obtained.

Each tender must be accompanied by a certified bank cheque on a chartered bank equal to five per cent. of the amount of tender and made payable to the City Treasurer, said cheque will be returned to those whose tender is not accepted, and in the case of those whose tender is accepted, cheque will be retained until the signing of the contract and commencement of the work.

The City Council reserves the right to reject the lowest or any tender.

J. EDINGTON,
City Engineer.

20-20

Tenders for Bridge Abutment

Sealed tenders, addressed to the County Clerk, Owen Sound, will be received by the Chairman, Road & Bridge Committee of the County of Grey, up to 6 p.m., **Saturday, the 27th day of May, 1916,** for the construction of a Bridge Abutment of Cement-Concrete at the Rocky Saugeen River, 4 miles north of Durham.

A marked bank cheque, payable to the Treasurer, County of Grey, for 5 per cent., shall accompany each tender, and will be returned upon non-acceptance.

Plans and specifications may be seen at the Clerk's or Engineer's offices.

The lowest or any tender not necessarily accepted.

FRED. RUTHERFORD,
County Clerk.
R. McDOWALL, C. E.,
20-21 County Engineer.

Tenders Wanted

The Board of Education of the City of Sarnia will receive sealed tenders, marked "Tender for Public School Building," delivered personally or by mail to the undersigned before four o'clock p.m., on **June 1st, 1916,** for the erection of an eleven-roomed school building. Plans and specifications may be seen at the Board of Trade Room, City Hall, Sarnia, or with the Architects, Messrs. S. F. Coon and Son, Ryrie Building, Yonge Street, Toronto.

Tenders may be for the whole building or any part thereof, and must be on forms supplied by the Board. Each tender must be accompanied by a marked cheque or approved bond of a Surety Company for five per cent. of the amount of the tender.

The lowest or any tender not necessarily accepted.

GEO. A. PROCTOR,
Chairman of Board of Education.
20-20

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

FOR SALE STEAM ROLLERS

One single cylinder Sawyer Massey 13 tons; one double cylinder Waterous, 15 tons. Both in perfect condition. Apply to Box 196, Three Rivers, Que. 19-20

Steam Rollers Travel Slowly—Motor Truck Will Hasten Trip

Steam rollers are slow travelers. On road work much time has been wasted and the work delayed while the roller was journeying from one distant point to another. The Kelly-Springfield Steam Roller Company hauls rollers from the plant to the railroad yards for shipment on a 3½-ton Kelly-Springfield motor truck, having found this a much quicker way than to drive the roller under its own power. This method could be followed to advantage by road contractors if the distance is great enough to justify it.

Loading a steam roller on to a motor truck on the job, however, is a more difficult matter than it is to load it at the shop, but the difficulty can be easily overcome. Most platform trucks are equipped with winches, either motor-operated or hand-operated. One way to get the roller up would be to place inclined skids at the tail of the truck, and draw the roller up with the winch. Another method would be to run the roller up on the bank—which is quite frequently a feature of the general run of country roads—under its own power and drive it along, laying down planks to facilitate its journey over the soft ground to a point where the bank is somewhat higher than the truck platform. Skids could then be laid down over the intervening gap and the roller easily placed on the truck. These are but two suggestions. Confronted with the task of doing such a job the average truckman would quickly devise a good method.

Stone Pavement in Rochester Undermined by Flood

Maximum high water in the Genesee River at Rochester, N. Y., recently caused the collapse of 12 square yards of the Medina block stone pavement, with its concrete base. The pavement caved in to a depth of 10 feet.

The washout was apparently due to the existence of an abandoned stone sewer 3 feet 9 inches wide and 5 feet 3 inches high, which was constructed in 1832 and superseded in 1863.

The water from the river, which at the time stood about 5 feet above the top of this sewer, entered it either through, or under, the present bridge abutment, or between the present and a former buried bridge abutment.

The water broke through an old egg-shaped sewer 1 foot 9 inches by 2 feet 6 inches, and entered an existing sewer manhole west of the bridge 18 feet below the surface. Flooding of cellars might have resulted had not the new sewer tunnel, 8 feet square and 40 feet below the surface, been sufficient'y completed so that connections with the existing sewer were made. The only inconvenience occasioned has been the closing of Main Street to street car traffic, during which time the local trolley company has taken occasion to renew its tracks in this locality. An investigation of the river end of the abandoned sewer will be made when the water lowers.

ESTABLISHED 1886

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Principal Contents

Who Supplies the Heat?

As long as specifications are written we presume there will arise questions which will admit of two interpretations and in such cases one can only be guided by precedent and common sense. Just at the moment we are in touch with a dispute between an owner and a contractor as to whose duty it is to pay for the coal that heats the building during part of the construction period.

There does not appear to be any question but that precedent places the responsibility on the owner. Few contracts make mention of this item in the specification and this, so far as we can learn, has invariably been interpreted to mean that the owner of the building buys the necessary coal to keep working conditions as favorable as possible. There is one slight difference in the specifications in question, however, in that the following clause occurs:

> "Coal, water and electric current will be supplied by the owner for all purposes that the heating contractor may require to effectively prove and test the system during the time of execution and completion."

The actual point in dispute is that, though the heating system was proved and accepted on January 18, 1916, work continued by the plasterer and carpenter up to March 26. The owner claims that the general contractor is liable for the cost of the coal between these two dates.

We cannot see how the insertion of this clause in the specification effects in any way the relationship between the general contractor and the owner, or between any of the sub-contractors and the owner, other than the heating contractor. No single case has ever come to our attention where the contractor has been held responsible for the heating of the building unless it was so definitely stated in the specifications, and in such cases we may say it has led to an infinite amount of trouble.

The work in question is on a church in the province of New Brunswick, where the custom does not appear to be different from that in other provinces of the Dominion. The writer knows of at least two very recent cases where different contracting firms completed large buildings in the province of New Brunswick. No mention was made in the specifications about heating, and the owners assumed the responsibility without the question ever being raised. We fail to see how any interpretation could be put on the contract in question that would place any responsibility on the contractor to pay for the coal to heat the building. Possibly some of our readers have been up against experiences of this nature and if so we shall be glad to hear from them, either for publication or for our private information.

Mill Construction and Fire Hazard

No one who has witnessed a large conflagration can fail to realize that the all-timber building cannot withstand terrific heat if directly in the path of fire. On the other hand, buildings of fireproof construction with fireproof walls and roof, such as are usually built to-day, will be seldom ignited and may be easily protected. It is not feasible, however, to build entirely of a fireproof material, such as concrete, because of the difficulty of securing machinery to the walls and floors. For this reason some builders prefer mill construction for the interior. To meet this requirement and still provide a fireproof structure, as far as possible, is the problem which confronts the present-day architect or engineer.

Experience in fire protection suggests that there should be as little combustible material as possible in the construction and equipment; each floor should be entirely cut off from every other floor, and each part of the building should be equipped with fire extinguishing apparatus. The advantage of reinforced concrete, other than the difficulty mentioned above of fastening machinery to it, is its incombustible nature. Fires may be confined to one floor with practically no danger to the remainder of the building. It must be remembered, however, that buildings of almost any form of construction are often destroyed by the burning of their combustible contents. The floor area should thus be kept down to a minimum consistent with the convenient and economical operation of the plant, and especially in a mill construction building of large area should be divided into sections by fireproof walls to prevent the rapid spread of fire.

If a mill work building is necessary, it should be of slow burning construction. Enough wood must, of course, be used to insure strength and stability, but surperfluous wood surface should be avoided. It is a question of considerable importance just how the quantity of timber to be used should be disposed. No architect with a thought for fire hazard will ever plan for either manufacturing or mercantile occupancy those regular fire traps known as "light joist" buildings.

In machine shops and other plants requiring especially heavy floor construction above the ground level, steel beams are generally used. In such construction provision must be made to prevent failure by expansion or buckling when subjected to heat. It is obvious that where steel beams or posts are used, they should be protected from fire by some sort of sheathing. Another matter which should not be overlooked in designing a building is the consideration of special fire hazards incident to the character of the work to be done within the building. Sufficient statistics are available on almost every well-known manufacturing process to indicate just what elements in such processes are susceptible to fire. Such hazards should be segregated to a separate fireproof compartment where fire may rage without endangering the rest of the structure.

There remain, however, after the observance of the points of construction, the consideration of fire extinguishing apparatus. It is obvious to any well-informed person that the manufacturer who builds today without provision for an automatic sprinkler system, almost wilfully endangers, not only the life of the building, but the lives of his employees as well. There are many details to be considered in fire protection in designing a factory, and the subject is dealt with in some detail by Mr. Franklin H. Wentworth, of the National Fire Protection Association, in a paper which is reproduced elsewhere in this issue.

Why Were Public Tenders Not Called?

CIRCUMSTANCES of more than usual interest appear to surround the letting of contracts for re-construction going on in old Knox College, Toronto. This is Government work, and, as such, the regulations required by law to be observed in the letting of Government contracts would naturally be followed. Two of these regulations are (1) that public tenders must be called, and (2) that a fair-wage clause must be inserted in the agreement. For some reason or other neither of these rules, it is claimed, were observed. In one case, at least, too, the wording of the specification appears to have been such as to eliminate any possibility of competition. Thus, in the plumber's specification the name of certain materials that must be installed are given and the name and location of the manufacturer. We believe the Builders' Exchange of the city of Toronto have taken the matter up and are investigating the circumstances surrounding the letting of these contracts.

Canadian No. 1 Construction Battalion

That engineers are the backbone of the war is apparent, and the need for more is evidenced by the fact that a Canadian construction battalion has been authorized and is well on the way with its recruiting. Two companies are to be raised in Ontario and two in Quebec. Recruiting has been actively under way for the last few days in Toronto and already approximately 200 men have enlisted. Active recruiting will commence immediately in Montreal for the 500 engineers required for the Quebec section. It is expected the battalion will be completed in a very short time and will proceed overseas shortly afterwards.

The construction battalion will work in conjunction with the Royal Engineers, and their work generally will be repairing and replacing works destroyed; also work on the lines of communication. The unit, which will be known as No. 1 Construction Battalion, is under command of Lieut.-Col. Blair Ripley, a civil engineer who has had long and varied experience in construction work in different parts of the Dominion. During the past ten years he has been employed as construction engineer with the C. P. R., and during that time has been identified with the erection of some of the largest viaducts in Canada. He was engineer in charge of the C. P. R. grade separation at Toronto up to the time of his appointment as Lt.-Col. of the Construction Battalion. The unit will be composed of 1,040, officers and men, and will be specially attractive to engineers and construction men. It has been raised at the direct request of the British War Office, and every officer in the battalion will be a civil engineer. The men will be instructed in railway construction, bridge construction and such work, by men competent in these lines of engineering work, The general class of men required is bridge and building men, construction men, and all classes of skilled and unskilled railway workers.

The officers who have been appointed for the battalion under the command of Lieut.-Col. Ripley, are: Capt. and Adjt. T. R. Loudon; Capt. J. H. Byrne; Capt. R. R. Holland; Capt. A. R. Ketterson; Capt. H. G. Henson, paymaster; Capt. V. G. Davis, quartermaster; Lieuts.—G. O. Fleming; J. B. Heron; F. G. Cross; H. R. McQueen; O. P. Hertzberg; H. L. Gilmour; G. S. Grant; and V. A. E. Steel.

Recruiting in Montreal will be in charge of Capt. Ketterson, with Lieuts. Cross and McQueen assisting him.

Road Dragging Competition

By lending financial support to road dragging competitions, the Provincial Public Works Department hopes to greatly improve Manitoba country roads. Instead of only fifteen municipalities taking up the competitions, the government desires that the 110 municipalities participate. An instructor will be appointed to assist in the work for not exceeding two months. An organizer will be appointed to assist in forming the new districts. The government will make a grant of $2.50 a mile of road entered in the competition and dragged for a season not shorter than May 1 to October 31.

The Manitoba Good Roads Association inaugurated the road dragging competitions, and the contests will still be under the auspices of the association, which will get the usual grant from the government.

A. C. Emmett, secretary of the association, will likely be asked to accept the position of organizer of the competition and districts.

The Design of Highway Bridge Floors

Determination of Loads and Stresses—Discussion on Different Types of Surfacing Materials

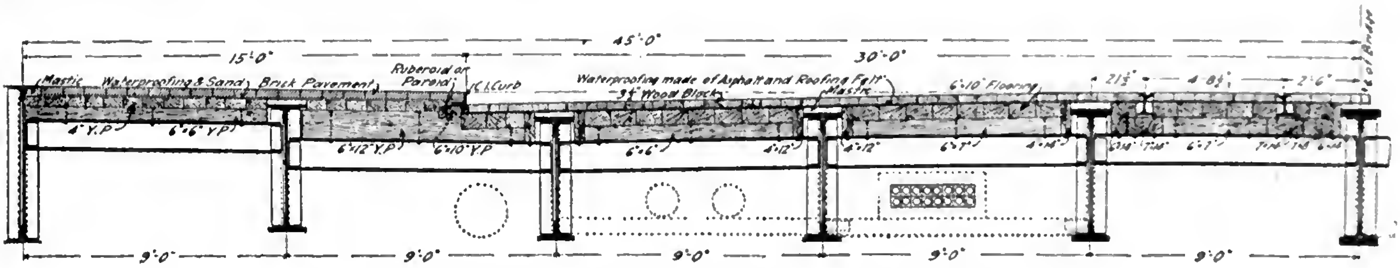
The design of highway bridges is more complicated than that of ordinary railroad bridges, partly because of the complications introduced by the paved floor and the provision necessary for supporting it and providing for its proper drainage, partly because of the varied character of the applied loads, and partly because of the difficulty in determining the width necessary to furnish reasonable accommodation for present and future traffic. The whole subject is discussed in a recent paper by Mr. Charles M. Spofford, before the Engineers' Society of Western Pennsylvania, with special reference to the floors and floor surfaces. The following extracts are from Mr. Spofford's paper:

For convenience in presentation, the subject will be treated under the five following main headings, each of which will be sub-divided:

(1) applied loads; (2) width of roadway; (3) wearing surfaces; (4) supports for wearing surfaces; (5) distribution of loads, computations and unit stresses.

Applied Loads

This subject may be treated under the following subdivisions:—(a) automobiles; (b) horse-drawn vehicles; (c) electric cars; (d) road rollers; (e) crowds of people; (f) miscellaneous loads, such as trains, water pipes, cables, snow, etc.; (g) uniform load and combinations of various live loads; (h) impact; (i) dead weight; (j) legal requirements.



A combined wood block and brick pavement.—Cost, including all other floor materials, 75c per sq. ft.

The uniform loads due to motor trucks are somewhat greater than the uniform loads usually specified for highway bridge trusses, but even were such trucks in common use no excess allowance over the ordinarily specified uniform load need be made for trusses or girders, except in the case of very short spans, as the probability of such a truck being on any bridge simultaneously with full uniform loading from other vehicles is practically nil.

As indicated by the following discussion of horse-drawn vehicles, it would appear that motor trucks are not used to handle the extremely heavy loads which occasionally cross city bridges.

In all large cities exceptionally heavy loads are occasionally hauled through the streets. Amongst the heaviest of such loads are machinery, parts of safe deposit vaults, steel girders, truss members, blocks of granite or other stone and heavy merchandise.

Experiments show that the weight of a crowd of people when carefully selected my reach the high figure of 181.3 lbs. per square foot. The writer once obtained a weight of 142.5 lbs. per square foot in his office by filling it with students selected at random. It is doubtful whether weights like this would ever occur in a mixed crowd consisting of people of both sexes and of varied heights. That extreme crowds may frequently occur on bridges is shown by experience, and that such loads may, over a portion of the bridge at least, amount to 100 pounds per square foot is readily believable. This is particularly true for bridges so located that large crowds may be attracted by reason of possible accidents on nearbly railway tracks or structures, by boat races underneath, by wrecks such as the recent overturning of a passenger steamer in Chicago on the river immediately adjoining a bridge, or by panic conditions occurring on the bridge itself.

Miscellaneous Loads

Amongst the miscellaneous loads which may be applied to bridge floors are electric trains, cable conduits, water and gas mains and similar structures. The weight of most of these may be given. Some allowance should be made for snow loads in the case of a highway swing bridge when in an open position, although it need not be considered in determining the stress with bridge in closed position, as the presence of snow on the floor would prevent the application of the full live load. The proper weight to be allowed for snow depends greatly upon the part of the country in which the bridge is located.

Combination of Live Loads

The question of what loads shall be combined in designing the various parts of the floor system is one that requires serious attention. The proper allowance to be made for impact on the floors of highway bridges is something upon which opinions vary greatly.

It would seem to the writer that a correct allowance for impact on highway bridges should properly vary with the character of the paving, the irregularity of an ordinary stone block pavement being such as to result in considerable impact, while a well-laid wood block pavement in good condition would produce but little impact.

Dead Weights

The following values may probably be safely used in determining the dead weights of bridge floors:

	Lbs. per cu. ft.
Hard (yellow) pine, 4 lbs. per ft. B. M. (Where protected by waterproofing and always dry; otherwise use 4½ lbs.	48
Creo-resinate yellow pine paving blocks ...	65
Spruce and white pine, 2½ lbs. per ft. B. M.	30
Bricks, pressed and paving	150
Portland cement concrete	160

Tar concrete (base for asphalt walks, etc.)	125
Silician rock (Simpson Bros.)	140
Trinidad asphalt (Barber Asphalt Co.), refined	74
As laid	140
Granolithic or artificial stone	150
Pavements (exclusive of sand cushion):	Lbs. per sq. ft.
6-inch granite block	80
4-inch brick	50
4-inch wood block (creo-resinate)	22
Roadway waterproofing:	
1¼ in. thick (felt, roofing pitch, sand and road pitch)	12
Buckle plates	10 to 20

Width of Roadway

The width of roadway necessary to provide for traffic of various quantities and intensities has an important bearing upon the design of the floor, and the writer has in consequence collected a considerable amount of data upon the subject.

The width of ordinary horse-drawn vehicles as measured in the streets of Boston is given in the following table, in which (a) equals distance out to out of hubs; (b) equals distance out to out of wheels; (c) equals distance out to out of whiffletrees:

	(a)	(b)	(c)
Hay wagon	7.75	7.00	8.00
Heavy express	7.65	6.70	7.90
Heavy express	7.80	6.70	7.60
Ice wagon	7.40	6.60	7.00
Hack	6.08	5.25	6.83
Coal wagon (3-horse)	8.50	....	10.83

Statistics upon width of and traffic upon various streets may be useful in determining the question of proper width of bridges. It should be borne in mind, however, that the capacity of a bridge in vehicles per hour is considerably greater than that of a street because of the freedom from interruption by traffic on intersecting streets and by vehicles stopping at the curb to discharge and receive freight and passengers.

Wearing Surfaces

Wearing surfaces for highway bridge floors may be classified under the following heads: (a) plank, (b) stone block, (c) wood block, (d) brick, (e) asphalt, (f) miscellaneous.

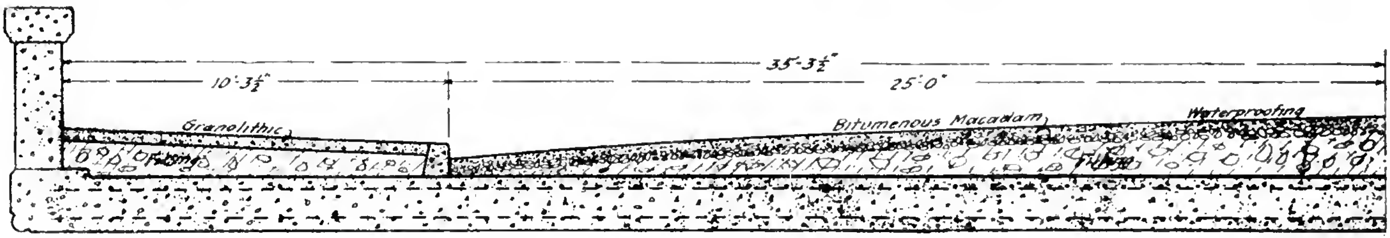
Plank

Such floors are commonly used for country bridges. They have also frequently been used for movable city bridges carrying heavy traffic where lightness of floor is important for economical operation, as well as for low cost of permanent structure, and has been considered as more important than the disadvantage due to frequent renewal of a plank wearing surface. The introduction of wood block pavement and of certain patented forms of wood pavement has, however, made it possible to construct a light floor much more durable than a plank floor and has in consequence done away, in part at least, with the temptation to use plank floors for city bridges except for bascule bridges, the floors of which must be so constructed that they will not slip off when the bridge is raised. Even if it is planned to use wooden sheathing at the outset to reduce the first cost of a given bridge, it would, nevertheless, seem wise to design the permanent structure to carry the weight of a wood block floor, as the additional cost would not be large and increase of traffic would probably eventually result in the demand for a better floor.

The common type of wooden bridge sheathing consists of two-inch spruce planks planed on one side to 1⅞ in. thick, laid either diagonally, at an angle of 60 degrees, or at right angles to the axis of the bridge, and supported on an under floor of untreated yellow pine to which it is nailed.

The life of spruce sheathing on bridges carrying heavy traffic in a wet summer, such as the past summer has been in Boston, may not be longer than from six to ten weeks, and the sheathing may have to be replaced five or six times per year, so that it is evident that it is bound to prove unsatisfactory. Attempts have been made in Boston to lengthen, by the use of preservatives, the life of such sheathing on bridges where, because of the lack of strength of the structure or for other reasons, the laying of a thicker and heavier pavement is impracticable. A number of preservatives have been tested and found to be unsuccessful. The writer is informed that Tylose preservative has given the best results and that planks coated with this on both sides have lasted 13 weeks, compared with 10 weeks for untreated planks laid alongside. Tarvia has been tried without success.

Untreated spruce sheathing in place on Boston bridges, laid in accordance with the specification recently quoted, costs about $38 per 1,000 cubic feet, $10 of which is the labor cost of removing the old sheathing and laying the new. This total price is equivalent to 7.6 cents per square foot.



Concrete arch bridge with a bituminous macadam roadway and granolithic walk.

Stone Block

Stone block pavement is very durable and admirably adapted for heavy traffic. It is expensive, both in first cost and in the weight it imposes upon the structure.

In Boston, it has been the custom to lay this paving on a sand cushion varying in thickness from 1 in. to 3 ins., the sand being necessary to take up the irregularities which occur in the blocks. The nominal depth of the blocks commonly used in Boston is 6 inches; in Philadelphia 5-inch blocks are used, and in Pittsburgh granite and limestone blocks varying in depth from 5 to 7 inches are specified. The length of granite blocks varies from 8 to 12 inches and the width from 3½ to 4½ inches.

Stone block pavement cannot be used on bascule bridges, as it would shift or slide as the bridge is raised.

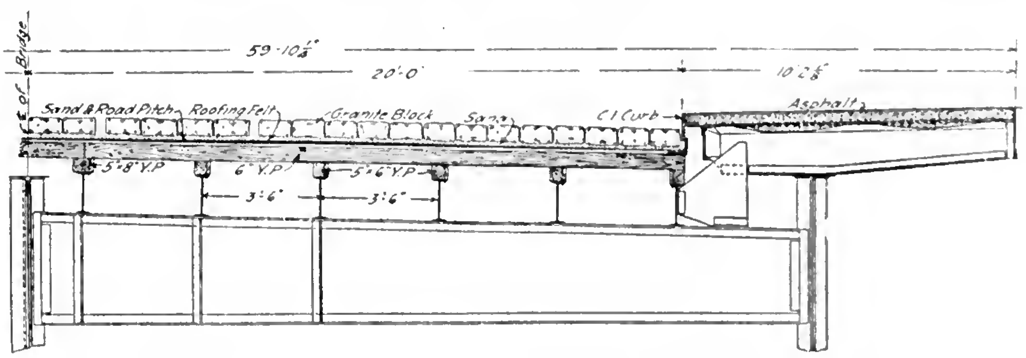
The cost of stone block pavement with pitch joints laid in place in Boston, exclusive of sand cushion, is at the present time about $2.50 per square yard. Its weight is about 90 lbs. per square foot.

Wood Block Pavement

Wood block pavement seems to be especially suitable for bridges, since, in addition to providing an excellent wearing surface, it is light in weight and regular in thickness, making it possible either to eliminate the sand cushion or to reduce it considerably in thickness. Great care must be taken in laying this paving to insure satisfactory results. The blocks should be thoroughly impregnated with preservatives, and expansion joints should be provided. The supporting surface should be sufficiently rigid to prevent disintegration due to deflection.

Experience in Boston would indicate that it is undesirable to lay wood block pavement directly upon a plank floor, or on other hard bearing surface, since the blocks are not uniform in thickness. A layer of asphalt mastic three-quarters of an inch thick, made of one part of asphalt and six parts of sand properly mixed and laid hot, has given good results on Boston bridges with timber sub-planking. Philadelphia specifications require the blocks to be laid on a layer of sand and cement 1 inch in thickness, mixed dry in proportions of one part of cement to four parts of sand, and sprinkled with water immediately before the block is laid.

Wood block pavement may be safely used on bascule spans if properly fastened. Mr. J. B. Strauss, of the Strauss Bascule Bridge Company, states that it is his practice either to toe-nail the blocks directly to the sub-planking, or else to lay steel angles spaced 4 feet to 6 feet apart and spiked to the sub-planking, these angles, which are laid at right angles to the centre lines of the bridge, being intended to act as shelves when the bridge is raised.



A granite block road floor on a sand cushion, with an asphalt sidewalk- Cost, 60c. per sq. ft.

Hexagonal wood blocks are sometimes use. The makers claim that such blocks knit together in such a manner as to equally distribute traffic loads, and that blocks as thin as 2½ inches may be used satisfactorily for bridge floors. The expansion of such blocks is radial and is said to be much less than that of rectangular blocks. The Public Works Department of Chicago is about to try this form of blocks, cut from young cypress, on a bascule bridge at Belmont Avenue, laying the blocks directly on a solid plank floor 6 inches thick. Every third block is to be face-nailed directly into the sub-planking, the fact that the blocks are all heart wood making it possible to do this without splitting the blocks.

The cost of 4-inch wood block pavement as laid in Boston in 1914, with a five-year guarantee, averages about $2.50 per square yard in place, exclusive of cushion. It varies greatly, however, with the density of traffic.

Brick

Brick pavements may be used on bridges with satisfactory results. Such a pavement is cheaper than a wood block pavement and lighter than a stone block pavement. The bricks should be laid on a sand or mastic cushion similar to those described under the heading "Wood Block Pavement," and expansion joints should be provided. The city of Philadelphia specifies that the bricks should be 3½ ins. in width, 4 ins. in depth, and 8½ ins. in length, and that they shall not vary in depth and width to exceed ⅛ in., nor in length to exceed ½ in. They are also required to have raised lugs on one side not to exceed ¼ inch in height. The cost of brick pavements in place in Boston is about $1.75 per square yard exclusive of sand cushion.

Asphalt

Asphalt pavements should not be laid on bridges except where a floor base of concrete or other rigid material is employed. It should not be used on bascule spans.

Miscellaneous Pavements

A patented pavement, the Shuman pavement, consists of narrow parallel wooden strips of maple, treated with asphalt and fastened together in the form of blocks about 2 feet wide by 5 feet to 7 feet long by 4 inches thick. This pavement is apparently no longer manufactured by the patentees, but it is still built by the city of Boston, which has the patent rights for municipal work in that city. This pavement is light in weight and can be securely fastened to a timber underplanking, making it especially desirable for bascule spans.

Macadam paving is probably seldom, if ever, used for other than reinforced concrete or masonry bridges, where it can be laid on a solid base in the ordinary manner used for street construction.

Supports for Wearing Surfaces

It is the writer's opinion that timber flooring consisting of yellow pine ties and planking is most satisfactory for ordinary city bridges. Such a flooring has been used with considerable success in Boston, and is the commonly adopted type of flooring in that city. Floors with timber sub-planking are also recommended for New York City bridges by Edward A.

Byrne, Assistant Chief Engineer, Department of Bridges, New York City.

The principal advantages of this form of flooring are its very considerable rigidity, combined with lightness and consequent cheapness for the bridge as a whole. If the timber planking is laid with tight joints such a floor is practically fireproof.

The life of yellow pine planking in bridge floors, when properly protected by waterproofing, is probably not less than twenty years, while the steel superstructure has been known to give out in less time than this.

Buckle plate floors have proven satisfactory for stone block pavement. They are not especially rigid and may give considerable trouble with wood block pavements.

Concrete and reinforced concrete floors and brick arch floors, while durable and rigid, are very heavy, and in consequence impose an unnecessarily heavy load upon the permanent structure.

Distribution of Load

The determination of the correct distribution of the applied load over the various supporting members of the floor system is a problem which does not admit of a definite solution, owing to the extreme statical indeterminateness of the system. The problem may be considered, however, under two heads: (a) the effect of the paving or other surfacing in distributing the load over its supports, and (b) the effect of the continuity of the supporting surface and of the street car rails in distributing the load over the stringers.

Distribution Due to Paving

The distribution under (a) is evidently a matter of experimental investigation, and so far as the writer is aware, no such investigations have been made. For a sheathed floor in good condition, considerable distribution may occur, but when the sheathing is old, none can be counted upon. It would, therefore, seem wise to make no allowance in the design of such a floor for the distribution due to the sheathing.

In the case of stone block paving laid on paving sand over a layer of waterproofing material, the distributing effect of the sand and waterproofing is considerable, and it would seem justifiable to consider a wheel load as distributed uniformly over the base of a frustrum of a pyramid with sides sloping at forty-five degrees and with an upper surface equal to the base of the paving block.

For brick or wood block paving a considerable arching effect may perhaps occur, but it would seem unwise to count upon this to distribute the load, which should be considered as distributed in a similar manner to that suggested for stone block pavement provided the pavement is laid upon sand or other yielding substance. If laid directly upon planks or other hard surfaces, no distribution can be counted upon other than that over the base of the block itself.

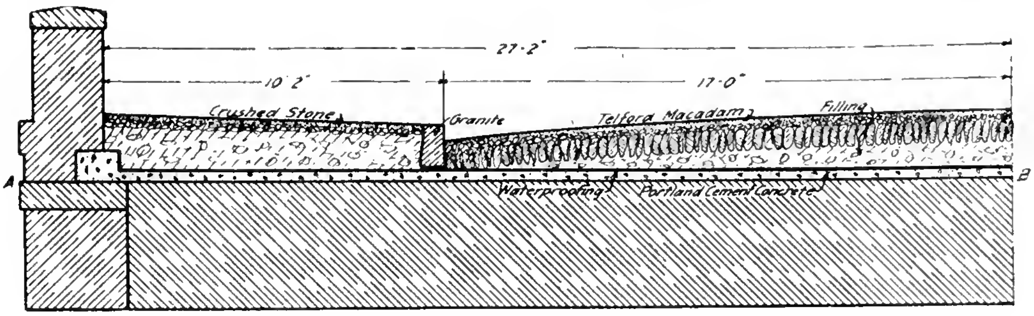
For a pavement of the Shuman type, described above, consisting of parallel strips laid edgewise, giving sections of some little length and considerable thickness, a reasonable distribution of the load will occur until the surfacing is reduced by wear so much that it should be replaced.

Distribution Due to Continuity

Under (b) an approximate analytical solution is possible, although such a solution should be used as a guide rather than as an accurate determination of the distribution.

The assumption commonly made in the design of railroad-bridge floors, that the rails distribute the load over three ties, may be properly made in the case of a highway bridge, but the tie loads resulting from a 50-ton trolley car thus distributed would be less than those coming from a 20-ton truck on two axles distributed through the floor planking, and hence would not ordinarily be the controlling factor in determining the size of a tie. It would seem proper, however, to test the strength of tie and planking for any given bridge by determining the stresses due to a derailed car, which case might readily be the controlling factor in the design.

The designer should bear in mind that the failure of the floor supporting surface would not result in the serious consequences that would follow the failure of the stringers or of the trusses and girders. Failures in the floor system occurring in well-designed bridges would be due to exceptionally heavy loads, in which case the burden of responsibility might well fall upon the transporting company.



Stone arch bridge with Telford macadam floor surface—Cost 39c per sq. ft.

Barrett Roof Guarantees

The Barrett Company, 17 Battery Place, New York, have given notice to contractors, architects, and other interested parties, that in future a twenty-year surety bond guaranty will be given without charge on all Barrett Specification Roofs of fifty squares, or more, in the United States and Canada, in towns of 25,000 or over, or any smaller place where the company's inspection service is available—provided the roof is laid by an approved roofing contractor and in strict accordance with the Barrett specifications. The experience of this company is that the Barrett roof will last for a minimum of twenty years without repairs and they are so convinced of this that they are willing to give a twenty-year guarantee. The bond will be issued by the United States Fidelity and Guarantee Company of Baltimore, one of the largest and best-known surety companies on the continent.

The Adaptability of Paving Materials

To Different Conditions and Localities—A Good Opportunity for Utilization of Local Materials—(Continued from May 17.)

By F. C. Pillsbury

Sand, in its natural condition is very seldom adapted to use on any kind of road surface unless used with some other material or as an auxiliary for the aid or relief of some kind of surface. Most sands, even those that are very fine, have qualities which make such use desirable. The fact has been well established that the particles of sand, when used in any bituminous or cement mixture for road purposes, should have a certain gradation from coarse to fine in order to obtain the greatest strength and other qualities necessary for superior endurance of the pavement. It has been found that even the loose sand of Cape Cod can be used without grading or the addition of other materials, except asphalt or asphaltic oil or tar, to give very practical results for country roads even when subject to considerable traffic and some heavy teaming, provided there is excellent drainage, particularly of the subsoil. This type of pavement, in the work done with the Cape Cod sands, is but an approximation of sheet asphalt, the difference being between extreme care taken to obtain sands of proper size, form and quality, and perfectly adapted asphalt for the sheet asphalt work, and the absence of any particular care except in the quality of the bitumen. Excellent results from sands are obtained when used in mixtures of other kinds, with gravel or broken stone. Experience has proved the advantage of using sand as a binder in laying water-bound macadam under certain conditions; also for stopping or arresting the ravelling of water-bound macadam. Its use with blanket or film coats of bitumen is well known. It frequently happens that bituminous macadam commences to break up under traffic from the effect of moisture and frost or moisture alone, and the prompt application of a layer of sand an inch or more in thickness over such spots prevents their breaking up. Fine loamy sands, quicksands, or others which absorb and hold moisture should be carefully avoided in the foundation, as their presence when too near the surface will lead to its destruction sooner or later. In such cases the same precautions and methods should be used in the foundations as when loam or clay is present. The sand-clay roads are also well known, but they are of little value in climates where frost action obtains. Sand is so various in its composition and formation and the results so various that unless its qualities are well known a careful study and analysis should be made before using in any important work. The use of sand not qualified for the desired purpose may lead to failure, particularly in high grade bituminous and Portland cement mixtures.

Gravel

Gravel occurs in such a multiplicity of forms and compositions that it is impossible in a paper of this kind to cover its use. Unless composed of rock which is too soft, or containing too much fine material, it is very valuable as a paving material and may be used in many different ways and for all kinds of traffic except that of extremely heavy weight. Its presence in the subgrade is desirable, and it may be used to advantage in most foundations, being better adapted for that purpose on extremely soft, moist soils, such as quicksand, loam, etc., than stones or telford. Its excellent qualities, however, frequently lead to its use where traffic conditions are too severe.

Clay, in its natural state, is of about as little value for road purposes as anything except loam. Its presence will generally lead to the failure of any surface that may be laid directly upon it, except in climates free from frost and surfaces subject to extremely light traffic. The writer considers that pavement a failure which does not carry the traffic for which it is designed, at a cost of construction and maintenance that is not at a minimum, although he realizes that there may be times when the financial condition of the community makes it necessary to adopt a surface that will not be satisfactory in those respects. The use of clay in the form of brick, while very successful from every point of view, under proper conditions, has failed sometimes for extrinsic reasons. It is essential that a brick pavement should be laid upon a stable base, especially in those climates subject to frost action. It should not be used under very heavy steel tire traffic. The writer has known of brick pavements being severely criticized when the fault did not lie in the brick, but when it was laid on imperfect foundation, or under unsuitable traffic conditions, or both. It makes an excellent surface for motor vehicles, and need not be slippery for horses. However, the greatest care should always be taken by means of testing to obtain brick of proper quality.

Stone

Stone, commonly speaking, is generally used in pavements by the following methods: in foundations, in water-bound macadam, bituminous macadam, bituminous and cement concrete and stone block pavements. There is frequently much waste of money in laying stone foundations, as they are often put in where unnecessary, or where clean, stony, or sandy gravel would not only serve the purpose, but to better advantage. This depends, of course, upon local conditions. The question is constantly arising between a choice of bituminous macadam or concrete and water-bound macadam. Almost always the choice depends upon the volume and nature of the traffic. Water-bound macadam will not carry any appreciable volume of motor vehicle traffic unless protected on the surface by some bituminous or other treatment, and even then the traffic must be light. Where there is much horse-drawn traffic it is sometimes better to surface with water-bound macadam, thus obtaining a surface which is generally less slippery, even if reconstruction is frequently necessary. There is much to be said as to a choice between bituminous macadam and bituminous concrete, but as with most other materials, much depends upon local conditions. There is a wide difference to be obtained in the quality of either of these pavements. This may be due to different methods, and is sure to follow variations in the quality of either the mineral aggregate or the bitumen. In the writer's opinion the local conditions should govern the choice and always the best materials available should be obtained. It is not necessary, beside being dangerous, to copy any set specifications covering these methods, and it is impracticable to lay down rules to be followed in making a choice. The natural materials that are most available should be taken and used to the best advantage according to their peculiar qualities. In many cases stone blocks might be used to much better advantage than they are, provided more pains were taken in laying the pavement, as well as in making the blocks. For those reasons many cities are now suffering from rough stone pavements. As stone pavements of good quality are probably the most permanent and will carry the heaviest traffic, they deserve more consideration than they have generally received. There is a difference of opinion as to the wearing qualities of certain kinds of stone.

Bitumen

Bituminous pavements provide for all kinds of traffic except the heaviest, by which is meant the extremely heavy traffic to be found in the large cities. Bituminous pavements have been the subject of so much discussion, and their uses are so familiar, that this paper will only mention in a brief way the more common methods, surface treatments and surface compositions, by either the penetration or mixing method. As stated under the use of broken stone, surface treatments of bituminous materials on water-bound macadam should only be used when the traffic is light, or where it is extremely desirable to have a good footing for horses, and in such cases where the traffic is at all heavy, it is better not to adopt the blanket coat method, but to use the film coat method, so-called. The choice between tars, oils and asphalts is often difficult to make. It is not possible to apply so-called heavy oils or tars except hot and in a blanket coat, as their consistencies are such that a considerable body of material is necessary to keep its place on the surface of the road. The lighter materials, which can be sprayed on cold, to cover the surface in much smaller quantity, will generally give more satisfactory and economical results. This is particularly true of so-called cut-backs or diluted asphalts. There are cases where tars for surface treatment seem to give better results than other materials, and the same may be said of nearly all materials used for surface treatments. Bituminous or other surface applications on macadam or gravel, or even on cement concrete, will never remain long enough to be economical where there is heavy teaming with steel-tired vehicles. Usually sufficient care is not taken in using bituminous materials in penetration or mixed work. Where proper care is taken in selecting the right kind of bitumen, and the right kind of mineral aggregate, and in the workmanship all the way through, bituminous pavements and surfaces should prove more economical than any others for all traffic of the present day, except for that which is very light or very heavy. It may not always be, however, the most desirable, partly on account of slipperiness which sometimes obtains, or local reasons. Its widely diversified qualities permit of its use under many different constructive conditions, and in pavements of very great difference in cost. It enables us to use sands, gravels, and rocks which would be practically worthless alone or with any other material than bitumen. Bituminous pavements have failed because of improper conditions in the base. Bituminous pavements do not fail any more than other kinds of pavements, when laid under suitable conditions, and composed of good bitumen, with the proper mineral aggregate.

The choice of materials also depends somewhat upon the treatment of the foundation. Moisture, with frost action, according to their degrees of intensity, with heavy traffic, usually require the most expensive and strongest pavements. So much depends upon drainage in such cases that where it is possible to obtain deep, open ditches on each side of the road, certain pavements will succeed without artificial foundation where without the side ditches or drains, even the strongest pavement would fail, as for instance, Portland cement concrete, or stone block on a concrete base. For the sake of comparison, consider climates where there is no frost action with that of New England. In countries where there is no frost action it would be extravagant to build the types of road required in New England or similar climates. On the other hand, it is impossible to build such light or thin pavements in New England as could successfully be built in those climates free from frost action, or comparatively so, and to have them withstand the weather conditions.

City Streets

City streets and the streets of the larger villages until recently were considered in a separate class from country roads, but during the past few years, and principally due to the ever increasing weight and volume of traffic, the main through roads and those connecting the larger centres of population, have come to be recognized as requiring practically the same treatment as city streets. Sometimes this treatment is more costly, as in the case of old highways where the foundations and drainage have to be taken care of, as well as the grades and alignments.

The greatest skill and wisdom is necessary in the reconstruction of old surfaces. There is much difference of opinion, and after all, the selection of materials in any case depends more than any other thing upon the knowledge and judgment of those making the selection. Advantage should be taken of the proximity of any natural materials that may possibly exist. This makes it necessary, if the wisest and most economical selections are to be made, to have a knowledge as wide as possible of all various types of surfaces, and all materials that are used for such purposes, including the materials in their natural state. It is with this in mind that the writer has ventured to discuss in a rudimentary way the simpler applications of the natural materials in their more common uses.

Coal Harbor Causeway at Vancouver

Providing the money can be spared from the various civic departments it is probable the long talked-of Coal Harbor causeway and entrance to Stanley Park, Vancouver, will be proceeded with this summer. The actual outlay involved is approximately $100,000, of which amount the Vancouver and District Joint Sewerage and Drainage Board will contribute $9,500 as its proportion of the sewer which is being laid in the sea wall. This work will form a link in the trunk sewer which reaches from Brockton Point through Stanley Park across Coal Harbor, and thence by tunnel along Park Road to English Bay, picking up the city's present sewers at that point, and ultimately reaching as far as Granville Street, along Beach Avenue, where it will intercept certain outlet sewers discharging at present into False Creek.

A Historical Sketch of the Grindstone Quarries of New Brunswick and Nova Scotia

As long as men have used steel tools there has been the need for grindstones and whetstones to give them an edge. This accounts for the fact that the quarrying and manufacture of these stones was one of the earliest branches of the stone business to be developed in this country. It is an industry, however, that is narrowly confined to the few localities where suitable deposits of sandstone are to be found. Canada has taken an important part in the production of grindstones and whetstones, for the reason that the sandstones of New Brunswick and Nova Scotia have been found particularly adaptable to this use. There is one fact that has made the production of Canadian grindstones among the most interesting of all quarrying operations in the world. The ledges of stone that are utilized for this purpose are on the coast line and extend out into the ocean. Much of the stone is actually extracted beneath the sea level.

One of the most important centres of the Canadian grindstone industry is at Stonehaven, Gloucester County, New Brunswick. The quarries of the Read Stone Company, which have been operated for sixty years are located there. The quarries are unique in their method of extracting the stone; the areas worked have been reclaimed from the sea by the building of dams. This has been no small undertaking. The dam around the present quarry which has just been finished, is over one-quarter of a mile long, and in all about a mile of dams has been built there. Anyone who has seen the Bay Chaleur in a storm will know that these dams must be very durable. They have been built chiefly of timber cribwork, filled with stone and heavily rip-rapped on the side exposed to the sea. The dams have been made water tight by the use of a clay puddle, pounded tight.

After the dam is built the water is pumped out and quarrying operations commence. The stone lies in horizontal sheets of varying thicknesses, the total depth of rock being about 25 feet. A steam channeller, steam and air drills are used as required and by the use of these and with powder and wedges the rock is quarried to the required size. It is then hoisted to the "dump" where the stonecutters take it and shape it round. From there, if it is not too thick for a single grindstone, it goes direct to the lathe to be finished. If the block is say two or three feet thick it is sent to the saws and cut to the required thickness. This applies to the larger stones, say 48 inches in diameter and larger. The smaller stones are split out of the irregular shaped pieces that come out along with the larger stones. The stones are cut round and shaped as a rough grindstone. In the olden days the grindstones were finished by hand by means of chisel and mallet. Now the rough grindstone is taken to the mill where the eye is drilled and the stone turned on a lathe in a very short time. Indeed, an expert turner will finish a small stone in five minutes. Many of the small grindstones, particularly the thinner ones, are made by sawing large blocks of stone into thin slabs, say 1½ to 2 inches thick. These slabs are then cut up into required sizes and the grindstone is finished on the lathe direct from the square slab.

The quarry is well equipped for handling stones. Three derricks are used at the quarry, two at the mill with a third in course of erection, and three at the wharf and station, while a travelling derrick operating under its own power and equipped with an orange peel bucket has been used for stripping purposes. One steam plant of 50 h.p. operates the hoisting machinery for the quarry derricks. Another of about the same capacity handles the pumping plant and the steam channeller. A 100 h.p. plant runs the mill machinery. This consists of an air compressor for the hammer drills used in the quarry, three gang saws, eight lathes, two scythe stone boxes, besides the necessary hoisting and pumping machinery, exhaust fans, etc. Water for the boilers is piped from a reservoir half a mile away.

The making of scythe stones is an interesting side line at this quarry. The block of stone is first sawed into slabs 1½ inches thick. These slabs are then broken under a special knife to pieces say 10 inches by 1½ inches by 1 inch. These pieces are then held under a weight to the surface of a revolving grinding bed. Sand and water are pumped on this bed and the stones are ground to a smooth surface.

In the early days at Stonehaven, the grindstones were quarried on the reefs at low tide, floated or hauled ashore, and finished by hand. These were perhaps the picturesque days of the industry, when men worked often to the waist in water, by day and by night as the tide suited. Stormy weather meant a partial stopping of the work. Shipments were made by scowing the stone out to schooners in the offing. At this time probably 300 men were employed. Later came machinery, and better shipping facilities, and now about 100 men are employed during the summer. Quarrying starts in May and ends in October. It is impossible to work when there is danger of the frost cracking the freshly quarried stone.

The grindstone industry of Canada had its beginning at the head of the Bay of Fundy, near Minudie, N. S., probably by the French, for local use, before the British occupation. Afterwards a British officer of distinction, Joseph Frederick Wallett DesBarres, later Governor of Prince Edward Island, secured a grant from the Crown, of Minudie and adjacent country, many miles in extent, and including the grindstone ledges at "The Joggins" as that part of the Bay shore was then called.

DesBarres later leased these ledges to his farmer tenants of Minudie, both French and English, who made grindstones by hand in a co-operative way. About 1815 Joseph Read and John Seaman, who came from Sackville, N. B., about 1808, leased farms from DesBarres' agent, acquired control of these ledges as shown by an old lease from the proprietors, and began regular shipments of grindstones to the United States in small vessels. The grindstone business has practically been in the hands of the Read and Seaman families ever since.

The business grew rapidly and was extended to other locations on the Bay of Fundy, both in Nova Scotia and in New Brunswick, the great tides of this bay baring the ledges of rock twice daily, allowing the rock to be excavated when the tide was low. With the rising tide boats were fastened over the loosened rock and large blocks were floated to high water level in convenient coves where, after the tide had fallen enough, workmen shaped the stones by hand into the grindstones of commerce. When a sufficient quantity had accumulated at any one place a vessel would come for them, grounding in a prepared berth near the grindstones (there were no wharves) and they would be hoisted on board by the quarrymen, no light task as many of these stones weighed over three tons. Later oxen and horses were used for hoisting.

Mill Construction and Fire Hazard

The Responsibility of the Architect and Engineer in Designing and Erecting Modern Buildings

By Franklin H. Wentworth*

Architects and builders are slowly entering into a new phase of their accountability. Just as the architect, whose primary impulse is that of the artist, has been compelled in the interest of his clients largely to master the technique of the builder, so both the architect and the builder are now being called upon to protect their clients in the matter of fire hazard. The enormous aggregate of the American fire waste, which contrasts so unfavorably with European prudence, is beginning to cripple and impoverish us as the natural resources of the country, once believed to be inexhaustible, are ceasing to respond to the demands of our habitual extravagance. The common notion that the insurance companies pay the cost of fires is gradually giving way to an intelligent understanding of the fact that they are merely the collectors and distributors of the fire tax. They must recover from the public the sums they pay out in losses, plus the cost of conducting their business and a reasonable interest upon their capital. If they could not do this there would be no business of underwriting, and sufferers from fire would be relieved only by direct assessment upon their more fortunate neighbors. It is not certain that a year or two of such direct assessment would not be an admirable educative experiment. At present the cost of the fire tax is merged with everything we eat and drink and wear, and the masses of the people are ignorant of the fact that they bear it.

This is no longer true of the manufacturing classes, however. The manufacturer now realizes that he pays a tax directly related in amount to the character of the building he occupies and the nature of his manufacturing processes; and that in addition to this he pays for the carelessness of all his neighbors. If he cannot shift this burden by passing it along to the users of his product, merged quietly in the selling price of his goods, then he must pay it out of his profits, which cripples him in the competitive struggle.

The manufacturer now clearly sees this and expects the architects and builders he may employ to see it also. If, after his factory is completed, he finds that points respecting the fire hazard have been ignored and that in consequence of some structural qualification, now too late to alter, he is doomed to pay a fire tax which forethought, with perhaps no additional expense, might have avoided, he may be considerably disturbed by it.

Experience in fire protection engineering suggests three points to be kept in mind in planning a factory:

1. There should be as little combustible material as possible used in its construction and equipment.

2. Each floor should be absolutely cut off from every other floor and each section from every other section, so that fire may not communicate.

3. Every part of the factory should be equipped with fire extinguishing apparatus.

It is obvious that a factory of reinforced concrete will present certain advantages respecting the fire hazard over the slow-burning or "mill construction" type; although the latter is preferred by many manufacturers as presenting more convenient surfaces for the attachment of pulleys, shafting and machinery. Slow-burning construction is not undesirable if properly safeguarded and protected.

Advantages of Reinforced Concrete

The advantages of the use of reinforced concrete appear when we consider that with such construction every floor may, by avoidance of vertical openings through it, be made practically a fire wall. The floors being incombustible, a fire in any storey may be ordinarily confined to that storey. In the old type of factory, having open elevator shafts and belt openings from floor to floor, fire quickly ran from storey to storey, and was soon beyond the control of the firemen. It is essential that in all factories, of whatever type of construction, stairs, elevator and belts be placed in fireproof enclosures with openings to each floor protected by fire doors or shutters. If in addition to the omission of all vertical openings provision be made to drain the floors through scuppers set into the outside walls, the possibility of water damage to goods or materials on floors below is much lessened. The standard form of brick or concrete stair and elevator tower may also serve this purpose. If the building as a whole is of fire-resistive material, it naturally presents less fuel upon which a fire may feed, and there is therefore less chance of a serious fire if for any reason the extinguishing agents are temporarily disabled. It must be remembered, however, that buildings are often destroyed by the burning of their combustible contents, and in all types of mills and factories the floor area should be kept down to the minimum limit consistent with convenience and economic operation of the plant. These areas should be divided by fire walls, all openings in which should be protected by standard self-closing fire doors. These precautions minimize the danger of a rapid spread of fire horizontally. All mill-constructed buildings, if of large area, should be divided into sections by special fire walls extending above the roof and out beyond the walls of either side.

Steel Window Sash

Whether exposed to possible fire from adjacent buildings or not, there should be no wooden frames or trim about the windows. Window frames should be of metal fitted with sashes of wired glass, for under strong draught fire frequently creeps up outside from storey to storey by means of the windows, con-

* Of the National Fire Protection Association in Architect and Engineer.

suming the wood trim and igniting contents of the building on each floor. Metal window frames are now so constructed that they will stand very considerable exposure to fire without buckling or releasing the glass, and, their liberal use in all varieties of buildings is greatly to be desired. The sashes may be operated as conveniently as those of any other window.

It will be observed that all the suggestions made for fire walls, stair and elevator enclosures and window openings are as applicable to buildings of mill or slow-burning construction as to those of concrete.

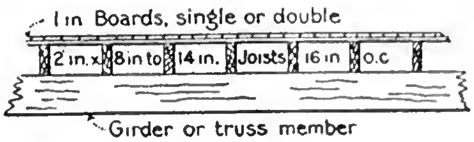


Fig. 1

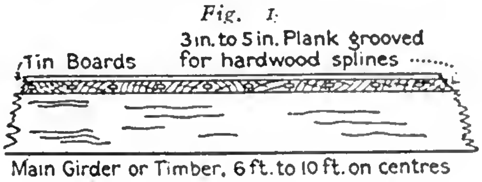


Fig. 2

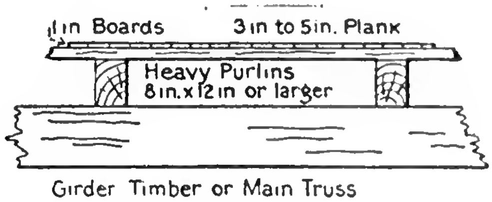


Fig. 3

Desirable and Undesirable Forms of Construction—Fig. 1, Undesirable because of the large amount of fire exposed wood surface. Figs. 2 and 3 Desirable Forms.

They should be followed, as far as possible, in all factory construction and in mercantile buildings as well.

In certain buildings of mill construction, carrying stocks of excessive weight, it has been a common practice to make the main beams of two pieces of timber side by side, bolted together. An air space between the pieces was formerly advocated in behalf of better seasoning and possible avoidance of dry rot. Experience has demonstrated, however, that this space not only reduces the resistance of the beams to fire by offering almost double the wooden surface to its attack, but that in case of fire getting started the space between the beams holds it for a long time and prevents its extinction. It is abvious that neither automatic sprinklers nor ordinary hose-streams can successfully reach fire lurking in such narrow alleys. Such construction should be avoided.

Slow-Burning Mill Construction

Mill or slow-burning construction presents its own inherent problems. Enough wood must be used to insure strength and stability, but superfluous wood should be avoided. It matters very much as to just how the quantity of timber used may be disposed. The guiding thought of the architects should be to present to the fire attack the least practicable amount of wood surface.

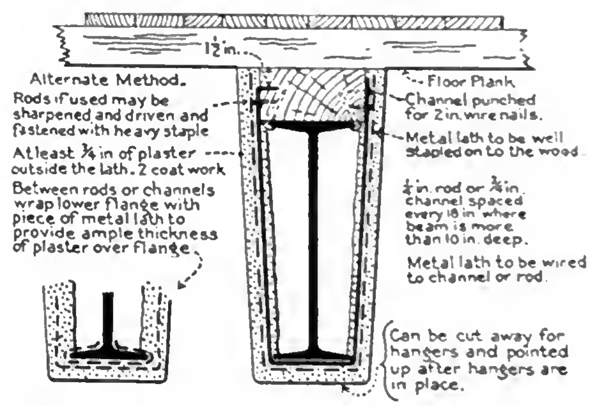
For example, a mill planned with heavy beams eight to eleven feet on centers of continuous spans from wall to post or post to post of from twenty to twenty-five feet is infinitely more desirable than one of miscalled mill construction having longitudinal girders resting upon posts on which girders are placed four feet or less on centers. The latter construction not only adds to the exposed wood surfaces which may be attacked by fire, but the disposal of the timbers obstructs the action of sprinklers and prevents the sweeping of hose streams from one side of the mill to the other.

No architect with the consciousness of the fire hazard will ever plan for either manufacturing or mercantile occupancy those undesirable fire boxes known as "light-joisted" buildings. Light joists or rafters two or three inches in width, spaced from ten to sixteen inches on centers, ignite and burn like kindling. Their numerous corners furnish projections for easy ignition. The menace of such construction may be aggravated by sheathing under the joists. This provides a series of wooden cells, pervaded with concealed spaces in which fire may riot and lodge and dodge extinguishment until the floor or roof is burned through. By the same token partitions of light wood should be avoided.

Timber posts offer greater resistance to fire than wrought-iron, steel, or cast-iron pillars, and are preferable in mill construction. Experiments show that sound timber posts of the proportion customarily used in mill work yield by direct crushing and not by crippling, the strength being directly as the area of cross section of the smallest part. The columns yielded at about four thousand five hundred pounds per square inch, confirming the general practice of allowing six hundred pounds per square inch as a safe load. Square columns are therefore one-fourth stronger than round ones of the same diameter, and do not encroach to any appreciable extent upon the floor space. It is the general practice to bore a hole one and one-half inches in diameter along the axis of the column to reduce checking. This should be done in any event, for if posts of unseasoned wood should by any chance be painted, varnished or filled, they are liable to be attacked by dry rot if unventilated.

Case Steel Beams

In machine shops and other plants requiring exceptionally heavy floor construction above the ground level, steel beams are frequently called into service.



Suggestion for Fireproofing Steel Beams

Fig. 4

With these, if wide spacings of from seven to twelve and one-half feet are maintained, the advantages of standard mill construction are not forfeited if the steel members are suitably fire-proofed. Desired floor stiffness between beams may be secured by making floors of two-inch joists on edge spiked together, the thickness of the floors varying with the loads and span from five to eight inches or more. This floor being practically a single unit, provision must be made for longitudinal contraction by making a continuous joint in the under flooring at intervals, with, of course, arrangement for tying the building together. One thickness of hard, close-grained floor boards laid over planks with two layers of resin-sized paper between is a good floor. A method that is growing in favor in high-class factories is to lay a board flooring diagonally or at right angles to the plank, and over that a top floor of birch or maple laid lengthwise. This intermediate floor gives great resistance to the lateral strain or vibration. It can be made of cheap lumber and in many factories is well worth the additional cost.

It is obvious that where steel beams or posts are used they should be properly protected. As steel or wrought iron, when heated, will fail by buckling or bending before an equivalent beam or post of wood will be dangerously affected, it is of importance that steel members essential to the stability of the structure be fireproofed; otherwise a fire in a lower storey may bring down in wreck everything above it. Where steel beams support wooden floors they must be fireproofed if they are to resist fire as well as the floors. The accompanying cut gives in detail an inexpensive method of protecting steel beams, and this is also applicable to wrought iron or steel columns. A more substantial method is usually advisable for the latter, however, and protection against mechanical injury near the floor should be provided.

Special Fire Hazards

There is another matter which should never escape consideration in building a factory. This is the special fire hazards incident to the character of the factory product. The picker room of the cotton mill is a luminous example. Here fire frequently occurs from foreign substances striking the pickers and igniting, by the accompanying spark, the inflammable cotton. Sufficient statistics are now available on almost every well known manufacturing process to indicate just what elements in such process are especially susceptible to fire. Bulwarked by this knowledge, it is prudent to segregate from the principal values of the factory all special processes demonstrated by experience to be especially hazardous. This does not mean that such processes must be carried on in separate buildings at the cost of traveling time and inconvenience. The problem of segregation can now be met without shifting the process out of its logical place in the routine of manufacture. In a fireproofed factory only a separate room, or at best a separate floor is needed. The manufacturer who, once when he had a fire in some room where volatile oils, for example, were used, commonly lost half his plant, or at any rate so drenched his premises with water as to make a fortnight's suspension necessary, can now, if he likes, so dispose that hazard as to have a fire every other day without disturbing the other parts of the factory. The modern fireproof room equipped with automatic sprinklers, having a slightly pitched floor and scuppers at the walls, can be flooded for fire extinguishment without a drop coming through below. The water runs as harmlessly from it as from the deck of a ship.

In mill construction it is easy to fireproof the floors and ceilings of any room in which quick, flashy fires are liable to occur. In the picker rooms of cotton mills a similar protection to that above suggested for steel beams is often used, the metal lath being applied directly to the under side of the planking and around the beams.

With the general outline so far given for his guidance the architect or builder will have before him the main points in building construction for the protection of his clients respecting the fire hazard. A consciousness and proper consideration of them may save many dollars in insurance premiums, and at the same time provide an attractive risk that with suitable further protection can hardly under any circumstances prove a total loss. There remains, however, after observance of the points of construction, consideration of the fire extinguishing agencies. These may appear to be outside the proper province of the architect, but his knowledge of their character and importance will help vastly in the convenience of their installation, and a little preliminary thought about them may save much tearing out and minor reconstruction. The architects who led the van in providing shafts, channels and runways for electric wires before such conveniences were demanded by inspectors, saved their clients an incalculable amount of annoyance.

Automatic Sprinklers

It is obvious to any well-informed person that the manufacturer who today builds without provision for automatic sprinkler protection almost wilfully endangers not only his plant, but the lives of his employees. It is not sufficient that the building be fireproofed. Fireproofed is but a relative term. Buildings of fireproof construction are often wrecked and ruined by the burning of their contents. Provision must be made for the extinguishment of a fire the moment it starts. Automatic sprinklers will do this if properly installed with an adequate water supply. Where a sprinkler system fails it will in almost every case be found to have been somehow neglected previous to the fire. Automatic sprinklers, with their increasing adoption, have almost eliminated a kind of fire which used to be especially destructive; namely, explosions of gaseous products generated by previous slow and imperfect combustion in stock or goods. Automatic sprinkler protection should, therefore, be considered imperative and intelligently provided for, and all concealed spaces or places difficult to protect properly by such a system should be studiously avoided. Vast inconvenience may be obviated by architects and builders giving thought to this point. Ample water supply for the average factory demands two independent sources. One should be by gravity and of sufficient volume and pressure to afford a good supply until the secondary supply can be drawn upon. Pumps, tanks and other details are not within the scope of this article; nor are fire pails and hand chemical extinguishers which need no advance provision, being placed in any convenient or desirable location.

Stand Pipes for High Buildings

The architect should give thought to a stand-pipe system, however, in factories of three storeys or higher. They are invaluable for carrying water for hose streams to upper floors, thus making unnecessary the handling of hose on ladders or on stairways, which is difficult and often entails costly delay. They should ordinarily be placed in the main stair towers, or at any rate on the opposite side of the wall from the rooms or buildings they are designed to protect. Where buildings are near enough to each other for the roofs to afford vantage points for use of hose streams, stand-pipes should be extended to supply roof hydrants.

In factories having loose combustible stock in process an equipment of small linen hose on each floor is invaluable. It is best to supply this from an independent system of small pipes. It may then be available in case water is temporarily shut off the sprinklers, or in final extinguishment of smouldering sparks after sprinklers have been shut off to save excessive water drainage.

There are many other details to be considered in properly protecting a factory from fire, but they are details in which the fire protection engineer is not dependent upon the provision or co-operation of the architect. If the points touched upon in this article have been made clear enough to enable the architect or builder to gain a general survey of the responsibilities his clients are coming to impose upon him, the absence of technical instruction will not impair its value.

The Utilization of Pulverized Earth in Asphaltic Mixtures

By Francis P. Smith*

[This paper is a discussion of Mr. Pillsbury's paper on "The Adaptability of Road Paving Materials to Different Conditions and Localities," which is concluded in this issue of the Contract Record.]

Mr. Pillsbury, in his paper on The Adaptability of Road Paving Materials to Different Conditions and Localities, discusses the fact that through changes in the process of manufacture and possibly in cementing mediums used many materials which are not now considered advisable for paving purposes may prove to be very valuable.

This is particularly true as regards broken stone or sand in which the particles are covered or closely associated with fine material of a more or less cementitious nature, such as clay or loam. Up to very recently such materials have been regarded as being unsuitable for paving purposes, owing to the fact that during their passage through the drier the finely divided cementitious particles have a tendency to form loosely coherent balls or attach themselves more or less firmly to the larger particles. When the hot mineral aggregate is mixed with bituminous cementing material the attrition of the mass in the ordinary type of mixer is not sufficient to remove the coating which has been formed upon the larger grains or to break up the balls of fine material. The bitumen, therefore, does not come in sufficiently intimate contact with the true surface of the larger particles to form a permanently adherent coating and only the outside surfaces of the fine mineral aggregate which has formed into balls receives a bituminous coating. Under the stress of traffic and climatic changes these balls are broken up and the interior of them, composed of loose pulverized material, is removed by the action of traffic, leaving pits in the surface in which water will accumulate. The coating of fine material, which to a certain extent has been formed on the surface of the larger particles, also becomes detached, carrying with it the coating of bitumen, thus loosening the bond of these particles and permitting them to ravel out.

It has been known for a long time that clay, owing to its affinity for bitumen, is a very valuable filler or constituent for pavements of the sheet asphalt type. It has heretofore been impossible to employ a sand containing appreciable quantities of clay for the reasons above stated and the use of ground clay as a filler to be added to the mixture in place of Portland cement or limestone dust has been impracticable owing to the tendency of the clay, even after being dried and ground, to absorb moisture and form into balls.

Recent developments in machinery for the manufacture of bituminous pavements have, however, rendered it possible to use materials containing a large percentage of clay. This is accomplished by subjecting the dried and heated aggregate to the action of a pulverizer in which the attrition of the particles is sufficient to break up any balls which may have been formed by the passage of the mineral aggregate through the drier and also to thoroughly clean the larger particles from any adhering clay or powder. By the action of the pulverizer the amount of 200-mesh material can be increased up to almost any desired point. The pulverizing action naturally exerts its greatest force upon the softer particles of the aggregate and the fine material formed is therefore largely derived from the softer ingredients and thus produces a more desirable dust or filler than can be obtained from pure quartz. Heretofore one of the serious problems connected with the paving industry, more especially where the traffic to which the pavement was to be subjected was extremely heavy, was the selection of sands which, when combined, would have the different sized particles present in the proper amounts to form a dense and compact pavement. In many cases it has been extremely difficult to secure such sands, more especially those which contain the requisite amounts of 100-mesh and 80-mesh particles. With the pulverizer, practically any amount of these fine particles can be produced from a sand which is naturally deficient in them. Where sands are naturally deficient in coarse particles of the 10, 20 and 30 mesh sizes they tend to make a pavement which is lacking in stability and is susceptible to displacement under traffic.

To a very large extent this instability of the mineral aggregate can be compensated for by an increase in the amounts of the finer particles. This is illustrated extremely well in French rock asphalt pavements, which contain practically no coarse particles and are largely composed of 200, 100 and 80-mesh particles. The action of the pulverizer, therefore, appears to eliminate a number of the difficulties attendant upon the use of former types of machinery for the manufacture of bituminous pavements.

Limit of Fine Material

This does not mean, however, that the action of the pulverizer should be permitted without proper supervision and regulation. A standard sheet asphalt pavement for heavy traffic usually contains a total of from 30 to 40 per cent. of material passing the 200, 100 and 80-mesh sieves. An increase of this fine material beyond a certain point results in increased instability of the pavement. After the critical point has been reached stability again increases. The amount of bitumen to be added to the mixture also depends

* Before the American Good Roads Congress, Pittsburg

upon the percentage of fine particles. As these are increased the surface area to be coated with bitumen increases and naturally calls for an increase in bitumen. Where the fine particles form the bulk of the mineral aggregate, it is often desirable to reduce the indicated bitumen contents caused by the increased surface area by thinning the consistency of the bitumen and making the coating on each grain thinner than in the normal sheet asphalt mixture. This can safely be done where the particles of the mineral aggregate (as in the case of French rock pavements) pack together very firmly when dry, and when so packed are extremely stable. Another difficulty is also met with in this connection and that is the tendency of a hot aggregate, containing a large percentage of fine material, to seggregate in the storage bins, thus making it difficult to draw from them a mineral aggregate of uniform mesh composition. This, however, is a mechanical difficulty which is not very hard to provide for. Mixtures containing large percentages of fine particles also require more thorough mixing than do those in which the proportion of fine particles is lower.

In asphalt block manufacture the bitumen used must necessarily be very non-susceptible to changes in temperature and is therefore relatively low in cementing value and fluidity. This makes it more difficult to thoroughly coat the particles with a firmly adherent film of bitumen and it has heretofore been absolutely necessary to use only clean, fresh broken stone in which the larger particles are free from adhering stone dust. It is probable that if a successful device can be installed which will clean the particles after their passage through the drying drums, stone which has not been freshly crushed may be successfully employed.

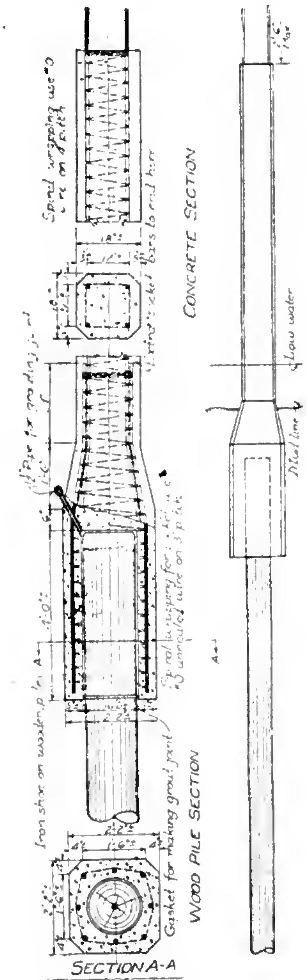
Experience covering widely different climatic and subsoil conditions is essential before any final judgment of the value of particular types of bituminous construction can be made, and what is one man's meat in one locality may well prove to be another man's poison in other localities.

A Combined Wood and Concrete Pile

COMBINATION piles, designed to resist decay and to be sufficiently strong and yet cheaper, it is claimed, than precast concrete piles, are now made with the lower portion of wood and the upper part of concrete. These piles are specially adapted for bridge or wharf construction or work on piers in water or low swampy regions. Wooden piles, while they will last for a long period if completely submerged, deteriorate rapidly if exposed to the air with sufficient moisture. Concrete piles are an ideal form of construction in so far as decay is concerned; they are also fireproof, but their disadvantage is their limited length due to their great weight and small cross section. They are initially more expensive than wood piles, and in places where the lower part is to be completely submerged, the combination pile should prove economical, in that is is cheaper and yet quite as permanent. Wood submerged or sunk in mud will last indefinitely.

The new pile is constructed of reinforced concrete, molded on the ground in either steel or wood forms prior to driving. One end is furnished with a socket for superimposing upon a wooden pile, the idea being to use the wooden pile in the ground below the mud line and place upon it the concrete socket pile.

Soundings are first made in the usual manner and the length of the wooden pile computed so that its top, when driven, will be a foot or two below the mud line. The pile is then driven to within a short distance of the water line. A collar of burlap or other material is placed around the pile at a point near where the end of the socket will come and the concrete socket pile is then placed over the wooden one. The socket pile is held up about six inches while all the space in the socket not occupied by the end of the wood pile is filled with grout through a small pipe fitted in the socket for that purpose and the pipe capped. The socket pile is then dropped into place and the heavy pressure forces the grout into all voids. The combined pile is then driven home.



Details of a Combination Wood and Concrete Pile.

The most severe test proved without doubt that the combination pile can be depended upon for at least as great efficiency as the ordinary type of concrete pile. It is also being used with success for repair work on many existing structures.

The Turbine Equipment Company, Limited, Toronto, have secured a contract from the Nova Scotia Steel & Coal Company for a 1,000 h.p. De Laval marine type steam turbine for one of the new boats being built by that company. The speed of the propeller is to be 80 r.p.m. and a set of double helical reduction gears are to be provided to reduce proportionately the speed of the turbine. The Turbine Equipment Company are also supplying the condensing equipment, bilge and boiler feed pumps.

Points to Bear in Mind in Laying Out Large Concrete Mixing Plants

Reinforced concrete is occupying such a large field in construction work of big dimensions that the question of distributing the concrete from a central mixing plant to remote parts of the work, is an item that involves considerable time and expense, and the plant and mechanical equipment necessary is very often expensive and occupies considerable space. Thus a

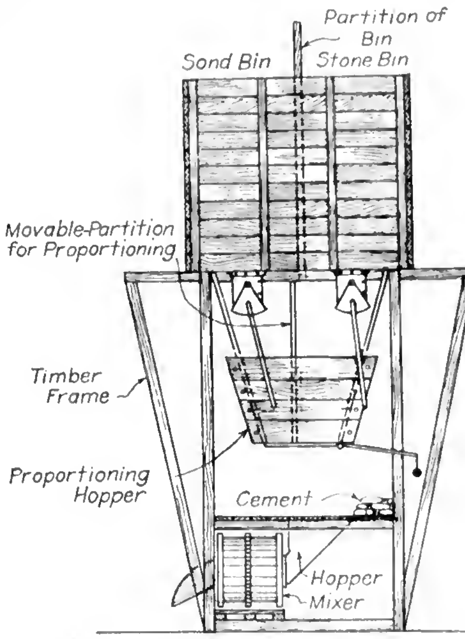


Fig. 1.—A convenient arrangement for storage bins and proportioning hopper.

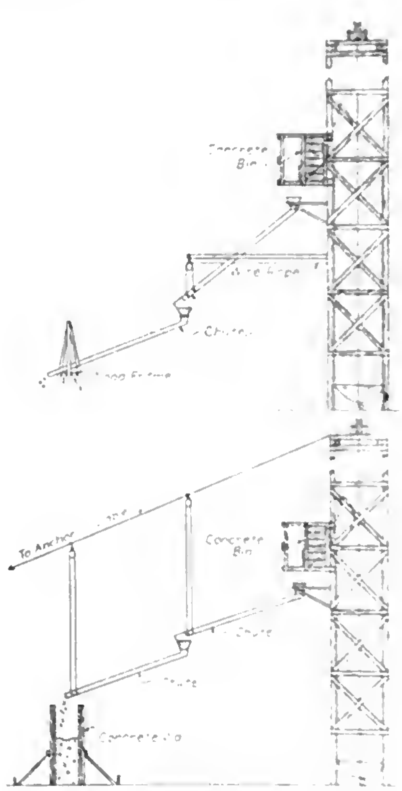
mechanical plant for any large structure should be carefully planned and laid out.

Concrete handling equipment may be divided into two general classes—standard and special equipment. The former consists of such machinery as a contractor may keep on band and use on any ordinary job, such as: standard mixers, wheelbarrows, cement buggies, hoists, etc., while the special equipment touches items not, as yet, usually included in a general contractor's equipment, but which must be built to suit the requirements of the work on hand. Such equipment might consist of standard cars and tracks, cable ways, storage bins, concrete chutes, etc. Special equipment, unless it can be used on subsequent jobs may not pay for itself on a single contract, as the extra cost would more than overbalance the saving in labor and eat up most of the profits. This must always be carefully figured out by the contractor beforehand.

Positive rules cannot be laid down for the selection of a plant for any and all types of construction, yet it is possible to fix a few general rules for guidance in fixing the type. Insofar as a mechanical plant is a substitute for labor, no more should be expended on it than would yield good returns. This is an item which has too often been overdone; too much has been expended for equipment. This should be specially guarded against, if it is at all uncertain whether the equipment will be used on any further contracts. Jobs vary so much that the distributing equipment for one may not be at all advisable for another. In many cases the difference in efficiency between the standard plant already in the contractor's possession and a special one which might be erected for a particular job, is not sufficient to warrant the extra outlay, since it must be charged directly against the one job. In whatever case, the plant efficiency is going to be gauged, both by its layout and operation.

A continuous automatic system of mixing and distributing concrete through simple standard conveyors that can be maintained and operated in any position, easily shifted and offering very little obstruction, is the thing desired. The figures herewith show a few common methods of handling and storing materials for a concrete job.

The advisability of a standard mixing machine is now practically universally conceded. It offers a very material saving in manual labor, produces a better and more uniform mix, and is productive of greater speed in construction. An efficient concrete plant is one in which all departments are kept going. Since everything is based on the supply of concrete, which may


Figs. 2 and 3.—Showing methods of supporting chutes.

be called the pace-maker, it should be as uniform and steady in its output as possible. For this reason it is important to adopt a mechanical mixer.

Mixing may be considered from three points, namely: charging, mixing and discharging. In charging the mixer a limit is set by the physical laws governing the flow of materials from one vessel into another, and the maximum efficiency for this operation is attained in proportion as this limit is more or less nearly approached. This time may be substantially cut by using carts holding about six cubic feet instead of the ordinary three-foot wheelbarrows, or by using a charging car; or, better still, by so arranging the mixer that the materials may be stored above it and be discharged into the hopper by the force of gravity, as shown in Fig. 1. This is perhaps the most economical and nearly ideal method.

Thorough mixing is quickly accomplished in any modern mixer, 30 to 45 seconds being ordinarily long enough for the operation, although for best results it perhaps ought to stay in the mixer one minute. Modern mixers are driven at from 16 to 20 revolutions per minute, and at each revolution the material makes four or more complete turns. For quick and uniform mixing, water should first be fed into the mixer in uniform amount. If the water is introduced before the material, it prevents the latter from adhering to the sides of the mixer.

To discharge the mixer requires from 10 to 20 seconds, depending upon the size of the mixer and the size and consistency of the batch. The all-important factor is the speed of the drum, a difference of 5 r.p.m. being enough to make a considerable variation in the time of discharge.

The arrangement of the plant, of course, depends on local conditions, the extent and nature of the work,

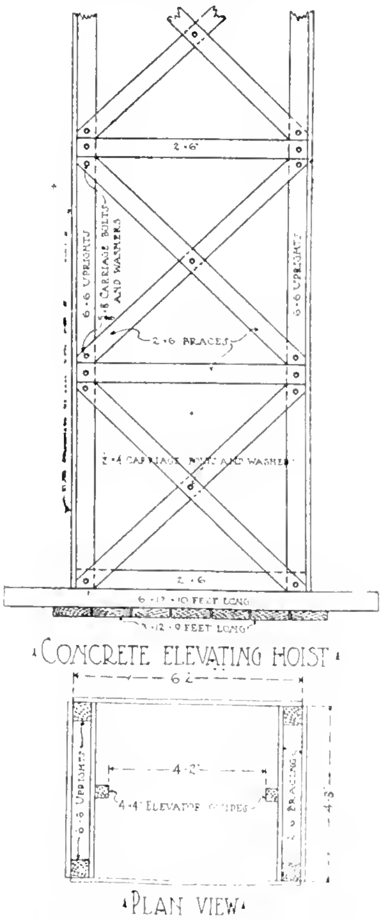


Fig. 4.—Details for a hoisting tower.

the contour of the ground, the accessibility of the site for delivery of material, and the available space for the plant. The material may come to the work either in wagons or cars and may be either dumped in piles convenient to the mixer or placed in storage bins. Cement is usually stored in a shed or placed under some sort of suitable cover. In many cases no special provision is needed for storing materials, but in others the handling of materials economically warrants some investment in storage bins. Fig. 1, already referred to, is an ingenious arrangement of a double apartment bin with sand in one side and stone in the other, so arranged that they discharge directly into a proportioning hopper below and from there into the mixer. It is generally advantageous to place the mixer below the level of the ground on which the material is placed. This is often done by setting it in the basement, if it is a building contract, or outside of the foundation in

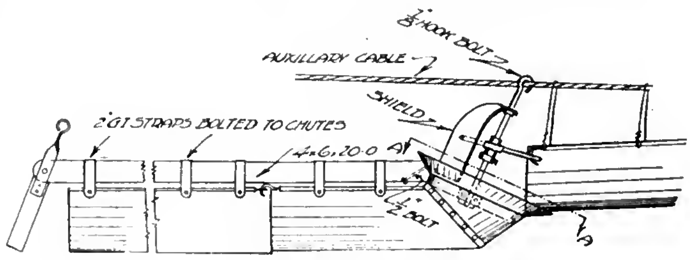


Fig. 5.—Details showing a chute joint, and method of suspension.

a pit excavated for the purpose. This facilitates charging. A special arrangement, a storage bin with a proportioning hopper, can be built, and by adjusting the movable partition, any proportion of aggregates may be had. In cases where the material is brought in by rail and the switch is at all distant from the mixing plant, it may prove profitable to carry the material to the plant on small side-dump cars, which can be elevated sufficiently to discharge directly into the proportioning hoppers or storage bins, the cars returning to the switch by gravity.

The position of the mixing plant depends on two factors—the location of the raw products and the distributing of the concrete. When a large mixer is once set up it should, if possible, be in a position to handle the entire job without shifting. This necessitates the use of chutes (see Figs. 2 and 3)to carry the concrete to different parts of the work. In some plants the concrete is carried from tower to tower by chutes, and re-elevated at each tower, making the use of one plant only necessary. The separation of the coarse aggregates and the mortar, however, is a grave danger in such plants, and should be watched carefully.

The tower and chute method of distribution, which has now generally supplanted the older method of wheeling the concrete in buggies to the forms, is shown in Figs. 2 and 3. The tower must be of suitable construction, rising from the mixer base to a sufficient elevation. Fig. 4 shows the details of a standard wooden tower such as is generally employed. It is built of 6 in. x 6 in. x 18 ft. uprights and 4 in. x 4 in. elevator guides, 2 in. x 6 in. x 12 in. fish plates, 2 in. x 6 in. braces, properly bolted. Further details are shown in the drawings. The elevator is usually driven by the same engine that runs the mixer.

Trip blocks and a receiving hopper are arranged to be adjustable to any height to suit the requirements of the work. The elevator, on reaching the block, trips and dumps into the receiving hopper, which usually has two discharge spouts, one near the bottom of each side. Each spout is fitted with a controlling gate and concrete may be discharged through either set of chutes at the will of an operator stationed on the tower. Figs. 2 and 3 show the most convenient form of supporting chutes—the cable from the top of the tower is run out and anchored and the spout lengths are suspended from this cable. Another method of supporting them is by derricks or by a boom supported by cables from the tower with a special A frame at the end mounted on wheels, which allows it to be moved about conveniently. Fig. 5 shows a joint between two successive lengths of chutes and the means of suspending the chutes from the catenary. The most convenient slope for the chutes is 1 vertical to 4 horizontal. Any excessive slope soon wears the steel chutes out, especially at the joints. The slope should gradually increase as the distance from the tower increases.

The volume of concrete construction throughout the country is becoming so great that it warrants the use of an extensive amount of standard and special equipment. Most of these items of machinery are used to profitable advantage, and with a little more study and experience, what is now special equipment may soon be called standard and be included in the general contractor's list of machinery.

The Effect of the War on the Price of Glass

The effect of the war on the price of glass, however the circumstances may be explained, has been that the year 1915 saw the lowest prices in the history of the glass industry. The situation indeed was so bad that three of the largest manufacturers in the United States were closed down, as a result, as one of the survivors recently put it, of "ruinous competition." The members of this trade are now naturally asking themselves, why? What do we gain by a price-cutting campaign that prevents even the strongest firms from making a living profit? There is little evidence that any more glass is sold at the cut price than if a fair rate were maintained. Would it not be better to get together and arrange a proper working basis on which a living profit could be made by whoever gets the business? Would it not be better to make the competition one of business-getting ability rather than of mere underselling?

A couple of interesting letters touching upon this situation have just come to hand. A solution of the difficulty has been suggested in a letter by Mr. Bradshaw, of the H. M. Hooker Company, to Mr. Cowan, manager of the Luxfer Prism Company, Toronto. Mr. Cowan passes the letter along to us with his own comment. Both letters are reproduced below:—

Toronto, May 15th, 1916.

Editor, Contract Record:—

I enclose a letter from one of the leading leaded glass manufacturers of Chicago, who is also an active member of the Ornamental Glass Manufacturers' Association of United States and Canada, and believe that he is striking a note which needs to be struck hard in our branch as well as in several other branches of the building trade. It is not for me to say that the different members of the glass business should unionize, but I do know, and every one of us knows, that something should be done to lift the business out of the slough of despond which it is in to-day and has been in for a long time past. This applies not only to the glass business, but also to certain sections of the iron business, with which we come in contact. Although we have secured certain contracts at figures which we consider quite low enough, we have been beaten out on others by figures 20 to 25 per cent. lower.

I feel satisfied that for the general benefit of the trade it would be wise if all the different members could wake up to the extent that we could get together and decide that prices be put on a basis where they would show a margin of profit. Each apparently at the present time is figuring to beat the other on a price basis. This simply has the effect that each is losing his money.

I do not believe that there is any object in keeping this sort of information under our hats, as it should be public property. Everybody in the business knows they are losing money, and the sooner we all wake up and get together the better.

I send this as a member of the Executive of the National Ornamental Glass Manufacturers' Association, and if you think it wise to publish this communication I will be very pleased not only to have this done but to co-operate in any way to improve conditions in the trade.

Yours truly,

Luxfer Prism Company, Limited.

Per W. Cowan, Manager

W. Cowan,
100 King Street West,
Toronto, Canada.

Dear Sir:—

It seems to be the universal consensus of opinion among the art glass trade, that something heroic must soon be done to put the profession on a paying basis, yet, no one has come forth with a solution of the acknowledged difficult problem. We are all fully aware that there are many defects to be cured, but what we are all interested in is the cure. We write about the abuses which are perpetuated, we criticize and sometimes condemn the other fellow, but fail absolutely to apply the cause to ourselves, and, as a possible remedy, may I suggest this one thought. **Unionize.**

We are not equally situated, we are not all sharing the same responsibilities, nor are we working under the same conditions, which make it very difficult to establish or maintain a uniform price, such as is being done among kindred trades. You see other lines of business advancing by leaps and bounds, and profits piling higher and higher, while your bank account, Mr. Art Glass Man, is most likely growing smaller and smaller. There is a reason. What do you think of a uniform scale of wages, and a standard form of working conditions? Would it not guide us in the direction which would result in the general up-lift of our business?

I am firmly of the opinion that a union of principles, backed up and regulated by a properly organized union of labor whereby we are all paying the same scale of wages, and working in harmony, will be the proper thing. What do you think about it, my Art Glass brother? This matter may come before our next convention, and an opinion from you at your earliest convenience, setting forth your views, so that we may be guided intelligently, in our future deliberations, will be highly appreciated at this time.

The art glass workers have federated with the Brotherhood of Painters, Decorators, and Paper Hangers of America. What are we going to do?

Sincerely yours,

G. N. Bradshaw

The new Dominion Observatory building on Little Saanich Mountain, near Victoria, is rapidly nearing completion. The dome to house the largest telescope in the world reached Victoria on March 22nd from the Warner & Swasey Works at Cleveland, the sections occupying eight cars and weighing 125 tons. With the dome came a quantity of special erecting machinery to aid in putting the steel work together rapidly.

Moulding Reinforced Concrete Lighting Standards by a Centrifugal Process

CONCRETE poles for carrying light and power, as well as serving for lighting standards, are quite common in the city of Toronto, which has perhaps the largest number of concrete poles of any city on this continent. The re-inforced concrete lighting standard is becoming recognized as superior to those of bronze, wood, cast iron, pressed steel, or copper covered. Not only in the first cost is the concrete designed lower, but in the matter of maintenance also. A new improved type of re-inforced concrete standard which has been manufactured for some southern California cities by a centrifugal process, is described in Concrete by L. R. W. Allison, of Newark, N. J. This process of moulding offers some interesting features of operation. The method of formation indicates, both in theory and practice, a logical and effectual means of production, at the same time showing reduction in cost factors that tend to enhance the extensive employment of these standards for all practical and economical purposes.

The fundamental principle involved in centrifugal concrete manufacture is that of effecting proper compression by centrifugal action. As is evident, in revolving a wet mix by this process the area of greatest compression is at the point of greatest radius. This affords the desired density in actions where it is most needed, resulting in a product, with cored center, of great structural strength and stability.

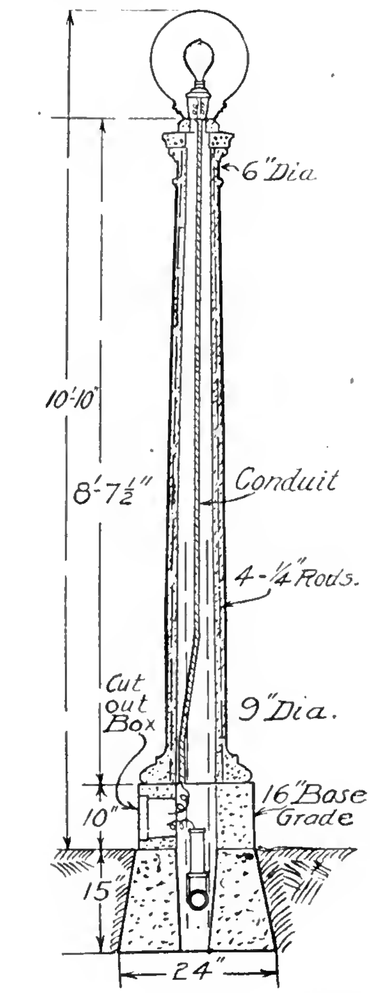
The hardest portion will be at the outside and the thickness of wall can be governed by the amount of material used. This placement of the heavier and the finer particles in concrete by centrifugal action, forming the densest mass at the outside, affords a consistent distribution in the proper proportions of the respective ingredients.

These standards are composed of a 1:3 mixture, consisting of 1 part Portland cement and 3 parts clean washed sand and gravel. This aggregate is mixed with sufficient water to permit pouring into forms which, of wood or metal as required, are of the desired outline and dimensions, and made in two or more parts as the exterior design may necessitate. The steel reinforcement is built up and placed in the mold, supported from the wall on a dead center.

When filled, the forms are locked in a machine and revolved at a proper speed to compact the mixture, sustaining the wet concrete against the walls. The exact rotating speed is dependent upon the diameter of the post. In this operation all voids are filled and the resultant product has a hard, smooth surface that cannot be obtained by ordinary tamping. The preliminary set is obtained in about 30 min. and the mold is withdrawn and allowed to stand for 24 hrs. before removal. After this time, the formed structure is capable of being handled without danger of injury to the surface; an additional curing in the open air, keeping the product thoroughly moistened, completes the process of manufacture.

A sectional view of a typical post is shown. The shaft is reinforced with four ¼-in. square twisted steel rods, equally spaced around the circumference and ¾-ins. from the outside wall. The rods are wired and held in place with No. 14 wire hoops. The standards have a hollow core, varying slightly for different types of design, but not less than 3 ins., extending from end to end. This core is concentric with the outside surface of the post.

The base, of square or octagonal pattern, as desired, and capital are cast separately under the centrifugal process. The former is provided with a 4-in. x 4-in. x 6-in. cut-out box with concrete cover. Foundations for the standards are cast in place, reinforced with



Concrete lighting standard manufactured by the centrifugal process.

⅜-in. twisted steel rods 5 ft. long in center, and the post securely anchored to this footing.

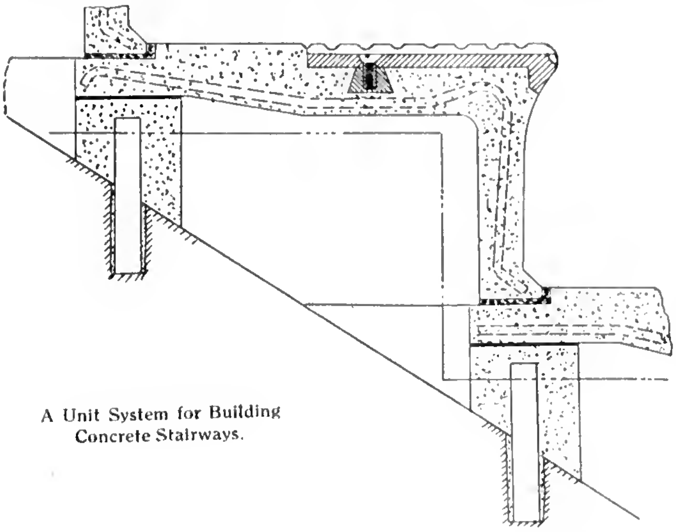
In finished surface these standards resemble cut or polished stone, which has resulted in the trade name of Marbelite. The post being hollow, is accordingly lighter than a solid column, and at the same time, is considerably stronger. Tests for absorption show that the surface of these posts take up less than one-half the moisture absorbed by well tamped concrete of the same mixture in a like period of time.

While this method of concrete manufacture is suitable for other products of post or column type, it has become particularly applicable in making reinforced concrete electroliers, and extensive activity is being given this line of operation. Classic designs modeled after Greek and Roman architecture are being adopted for various column types, supplemented by bases and capitals of harmonizing pattern.

Unit Concrete Stairway Construction

The method of casting unit stair concrete steps, which greatly facilitated the construction of concrete stairways for subways in Boston, is described by W. B. Conant, in "Concrete." The old method of setting up a timber form for each flight of stairs was found expensive because a considerable amount of lumber was destroyed in removing the forms. A unit system of casting each step was worked out, which proved to be from 33 to 50 per cent. cheaper.

The plan of casting is as follows: a cypress form of sufficient length to carry two 8-ft. lengths is used to give the face of riser and tread; i.e., the stair is cast in an inverted position. The base plate, 7 in. wide by 3/8 in. thick, to which a corrugated "safety tread" is attached, is laid face down on the form. Reinforcement consisting of 1/4-in. deformed bars, as indicated in an accompanying illustration, are placed in position; lateral rods bent to conform with the elbow of the unit are spaced at about 2-ft. 6-in. intervals in the length and wired to the longitudinal rods, the reinforcing being cast 1/4 in. from the outer surface.



A Unit System for Building Concrete Stairways.

End bulkheads are set in position and over these is placed the form for the back and the under side of the unit. This is screwed to the bulkheads.

Then the form is filled with a mixture consisting of 1 part Newburyport sand, 1 part cement, 1 part stone dust, 1/4 in. diam. and finer, and 1/2 lb. lampblack, the materials being measured by volume. Standard stairs are of 7-in. riser and 11-in. tread, with tread 1 1/2 in. thick and riser 1 1/4 in. thick.

As the concrete sets, the form is carefully troweled off to a finished surface, it being necessary to get an absolutely uniform thickness.

The unit is allowed about 24 hours to set; then the front form is removed and the riser finished. After one more day, the unit is turned over and the tread finished. Each stair is allowed to cure at least one week.

Preliminary to erecting, a flight of concrete stringers is cast against either wall, and for a wide stairway another stringer in the middle, each 8 in. to 12 in. wide. The practice is to snap a chalk line on either wall for a nosing line, and to set each unit to this, beginning with the bottom stair. Units are laid in a 1:1:1 mortar and where conditions make it necessary the spaces under the stairs are grouted with a similar mix through holes 1 1/2 in. in diameter cast in the treads by means of pipe sections. Otherwise, if the space beneath the stairs is accessible, the space is concreted from below.

Clayburn Firebrick & Clay Co., Ltd.

The Clayburn Firebrick & Clay Co., Ltd., Clayburn, B.C., are doubling the capacity of their plant by the erection of additional buildings and the installation of more machinery. The property of this large plant comprises over 800 acres about a mile from the Clayburn station of the British Columbia Electric Railway and includes the village of Clayburn, which is owned by the company and maintained for the employes. This village is equipped with all modern improvements—sewage system, electric light, and street lights.

Five miles of electric railway are operated by the company, as well as a line from the plant to Clayburn station. Mechanical operation throughout the entire works is by electricity. Their large mine, which is in Sumas Mountain, contains openings for seven different clays and shales of a variety, it is claimed, not existing anywhere else in the world. The clays run from from buff to bright red, covering practically the entire field of clay goods included in vitrified brick, and the company are now experimenting on paving brick. It has been found that on mixing two different clays a perfect non-absorbent brick was secured, which is now standard for the Vancouver sewerage system. All that is now required to perfect a vitrified paving brick is to combine the non-absorbent quality with toughness and in so doing the first vitrified brick manufactured in Canada will have been secured.

The material now in sight in the various clays—and the property has barely been touched—will last eight years and it is estimated that there will be sufficient raw material available to last for generations.

The importance of this Clayburn industry can be seen by the following figures of last year's output: 692 tons of prepared fire clay; 315,000,000 common brick; 250,000,000 pressed brick; 364,000,000 cut brick; 1,823,000 fire bricks; 839 tons of special goods (chiefly fire brick shapes); 217 tons of drain tile, and 432 tons of sewer pipe. The capacity of the plant as present is 25,000 fire brick per day, in addition to other wire-cut goods, in a ten-hour shift. Hand-made brick for building and dry-press brick can be turned out at the rate of 30,000 to 40,000 per day, and should building activity warrant, twenty extra employes could easily be accommodated.

At the present time the plant is working on a large order for the Trail Creek Smelter, which will be ready in a few weeks. Clayburn products have figured largely in building activity in Vancouver, being contained in the Hotel Vancouver and the big new C.P.R. station. The company has also, after persistent effort, succeeded in getting a strong foothold in the United States and have recently completed large orders in the States of Oregon and Washington.

The Clayburn Firebrick and Clay Company are the sole manufacturers of fire brick in Canada and it is one of the few industries unprotected by tariff regulations, while all other makes of clay products imported are subject to a 20 per cent. duty, fire brick comes in duty free. The present firm took over the establishment from the Vancouver Fire Brick & Clay Company in 1909, the officers being: President, W. H. Armstrong; vice-president, A. L. Russell; secretary, J. J. Plommer. Mr. J. B. Millar is general manager, and the Board of Directors includes Alex. Morrison, Rodge O'C. Miller, C. C. L. Wilson, J. H. Roaf, and Roy Miller. Of the total clay goods from Canada exhibited in the Canadian Building at the San Francisco Exposition, Clayburn products comprised one-third.

Manufacturing Concrete Fence Posts

METHODS employed by the New York Board of Water Supply in manufacturing reinforced concrete fence posts in connection with their work on the Catskill Aqueduct, were described by R. N. Wheeler in a paper before the New England Water Works Association recently. These posts were cast in thin metal forms in a horizontal position. Two methods were used, namely, the table and the battery methods. In the former the moulds were placed on a skeleton table, while in the latter a small steel car with hinged ends, designed to hold five layers of six moulds each was used. The table method was generally the more satisfactory of the two. It required a little more floor space, but it allowed better access to the forms for trowelling the faces of the posts at the proper time.

Mr. Wheeler gives the following hints as the result of his observations:

1. Moulds should be coated with a thin film of oil.
2. Concrete aggregates should be of two sizes, well graded; the fine up to 1/4 in., and the coarse from 1/4 to 1/2 in. for the smaller sections of post and 1/4 to 3/4 in. for the larger.
3. The mixture must be very accurately proportioned, analyses being desirable to determine the exact proportions. Generally about one part of cement to three parts by volume of aggregates gave the best results.
4. The concrete must be thoroughly mixed and of wet consistency.
5. The ends of moulds must be sealed tightly with clay, plaster of Paris, or cement, to insure good tops.
6. The air must be expelled by joggling and running a trowel back and forth through the mixture and along the sides of the mould while placing.
7. The reinforcement must be placed in correct position. This can be accomplished without a spacing device after a workman becomes skilled.
8. The reinforcing metal, particularly round wires, should be thoroughly rusted or nicked to give a proper bond. Bending the ends of these wires back 180 degs. gives good results. As received from the mill, these wires are greasy from the drawing process, and it is necessary to hasten rusting by the use of a weak acid afterward neutralized. Posts tested to failure show that unrusted straight wires pull through, whereas properly rusted ones, or those with ends bent, break. It has been suggested that running the wire through a barbing machine such as is used in the manufacture of barbed wire nails would deform it sufficiently to give a good bond. This would add not over one-half cent per pound to the cost.
9. Posts must be properly cured. They can be removed from the moulds in 36 hours, and may be stood in a vertical position and water sprayed over them from suitably arranged piping, or preferably they may be spaced in a horizontal position and covered with sand or sawdust kept wet. Curing should cover at least two weeks, and better four.
10. The rounding of edges of the exposed face can be accomplished in the form, but better by rubbing with a carborundum brick after erection and before the wire is stretched. If fencing is attached by wrapping wires, rough edges assist in holding the wires.

Welding Methods in Repair Work

The method adopted by the Pennsylvania Railroad for reconstructing cast-iron resistance grids of electric locomotives is as follows:—The grids are first sorted into four classes. The best are retained for reassembling; those slightly burned are ground on an emery wheel, while badly burned ones are re-ground and used at the insulated joints, the surfaces being separated by mica. The remainder are repaired whatever their condition. Broken grids are placed on a jig so that there is 3/8 in. clearance between the parts to be joined. A mould formed of old carbon brushes is placed around this space, and the crack is forced open 1/16 in. and the grid clamped to the jig to provide for contraction in cooling. After welding, and when the metal has cooled to a dull red heat, the clamp is removed to prevent breakage by contraction. The average cost of this operation is 10 cents, while a new grid would cost $1.05. The resistance units, after being re-ground or welded as described, are assembled on Mn-steel rods for welding, these being very hard and not affected by high temperature. It is found that in welding, the molten metal does not adhere to these rods, and they enable the holes through which they pass to be kept smooth. A fire-clay backing is employed to prevent the molten iron from flowing down between the grids. The bottom and side edges of the contact surfaces are then welded and the rods removed, after which the grids are reassembled on the insulated rods with mica washers between the joints, and the A-frames are put in place. The insulation is then tested with 1,000 volts alternating current.

This method has proved to be cheaper than acetylene welding, the details of cost being as follows:—

Removing burnt grids from locomotives, 2 men, 2 hours at 50c. per hour	$1.00
Grinding, cleaning, and repairing grids, 1 man, 2 hours, at 34c. per hour	.68
Assembling grids for welding, 1 man, 1 hour, at 34c. per hour	.34
Welding grids, 1 man, 3 hours, at 34c. per hour.	1.02
Assembling grids on locomotives, 2 men, 3 hours at 50c. per hour	1.50
Cost of electrical energy, 33 units at 1c. per unit	.33
	$4.87

The cost of the former method of replacing burnt sections by new ones and grinding and cleaning those slightly burned amounted to $14.40.

Obstacles to successful welding are sand holes, blow-holes, and slag piles.

Copper lugs have been successfully welded to cast-iron grids by shortening the arc to 1/2 in., and using 150 amps. The arc is confined to the iron until welding temperature is reached and then brought in contact with the iron and copper. Copper-oxide gas and copper slag are sources of trouble; the gas is heavy and masks the weld, while the slag, being but slightly darker than the molten copper, is difficult to distinguish from it.

The Toronto Bureau of Municipal Research have just issued their second annual report, covering the year ended February 29, 1916. The report covers what the Bureau has been working at during the year; what advances have been made by the civic government in city administration and by the community as a whole in community activities; and finally suggests some advanced steps for the future.

Canadian Overseas Railway Construction Corps Doing Good Work at the Front

IT has been truly said that modern war is engineering applied to manslaughter. It is an engineer's business, according to the classic definition, to use the great forces of nature for the service of man. How far the term, service, may be applied has

Lieut.-Col. C. W. P. Ramsay, O.C.

been brought out by the European war, where modern science is being applied to the destruction of the human race. The engineer may be held directly responsible for the mammoth scale and scientific manner in which this modern war is prosecuted.

The progress of the European war has demonstrated that engineers are needed as they never were before to insure the success of any great offensive or defensive movements. The work of the engineer has been justly recognized and the splendid service done by our Canadian engineers at the front, has been highly appreciated by the allied commanders. The work of the Canadian Overseas Railway Construction Corps, Colonel C. W. P. Ramsay, O. C., has attracted particular attention. The corps has already built many miles of track at strategic points, and is now engaged in surveys for further construction. The sudden demand for troops and supplies creates a condition which requires that means of communication and transportation should be supplied as rapidly as possible. The equipment necessary to carry on such construction must necessarily be the most efficient possible. To meet the conditions, the Canadian Government recently purchased for the C. O. R. C. C. a considerable amount of equipment, including some large steam

65-ton steam shovel purchased by the Canadian Government for the Canadian Overseas Railway Construction Corps.

Self-propelling track layer for the C.O.R.C.C.

shovels, weighing 65 tons each, capable of excavating at the rate of 150 to 200 yards an hour, and also some self-propelling extension track pile drivers. This equipment was purchased by Colonel Ramsay's colleagues in the engineering department of the Canadian Pacific Railway, and is being prepared by that company at the request of the Canadian Government for shipment to the corps. The illustrations show the types of machinery that will be sent. They bring home forcibly the immense proportions on which modern warfare is being waged.

Of the non-commissioned officers and sappers that enlisted on the formation of the C. O. R. C. C., eighteen have received commissions in the Royal Engineers, a remarkable tribute to their efficiency, while Colonel Ramsay and Major Harvey have been mentioned in dispatches. Work has often to be carried out under fire, and although there have been many narrow escapes, there have as yet been no casualties.

The Canadian Pacific Railway is engaged on a large programme of broken stone ballasting on a portion of its eastern tracks in the vicinity of Montreal The main line from Windsor Station to Vaudreuil, 24 miles, and from Place Viger station to St. Therese, 20 miles, is now being being ballasted with broken stone.

Two Scholarships for C.P.R. Employees

Mr. George Bury, vice-president of the Canadian Pacific Railway, announces, in a special circular, that two free scholarships, covering four years' tuition in the Faculty of Applied Science in McGill University, are offered to apprentices and other employees enrolled on the permanent staff of the said company, and under 21 years of age, and to minor sons of employees, the same being subject to competitive examination.

The competitive examination will be held at the University, Montreal, and at other centres throughout Canada, in June, 1916. The candidates making the highest average and complying with the requirements of admission will be awarded the scholarships and have the option of taking a course in any department of applied science.

The scholarship will be renewed from year to year, to cover a period not exceeding four years, if, at the close of each session, the holder thereof is entitled, under the rules, to full standing in the next higher year. In case a scholarship holder finds it necessary to interrupt his course for a year or more, notice must be given at the close of the session to the railway company and to the head of the railway department of the university, in order that the scholarship may be open to other applicants.

In order to establish prior claim to the next available scholarship, notice of the student's intended return must be given to the railway company and the head of the railway department not later than January 1st preceding the opening of the session available. Applications for certificates entitling eligible persons to enter the competition should be addressed to Mr. C. H. Buell, staff registrar and secretary pension department, Montreal.

On Active Service

The following members of the Calgary Branch of the Canadian Society of Civil Engineers have enlisted for active service:—

Members.—H. B. Muckleston, F. R. Burfield, Col. Paul Weatherbae.

Associate Members.—P. J. Jennings, H. R. Carscallen, F. S. Dyke, G. R. Elliott, J. A. Symes.

Juniors.—R. L. H. Goodday, J. H. Jones.

Students.—J. B. McLean.

Associate of Branch.—G. H. Whyte.

Edmonton Branch C.S.C.E. Elects Officers

A special meeting for the election of officers was held by the Edmonton branch of the Canadian Society of Civil Engineers on the 10th instant at the Cecil Hotel. About twenty members of the society resident in Edmonton were present at an informal dinner which was served at 7 o'clock. The following officers were elected for the ensuing year commencing in October next:—chairman, L. B. Elliot; vice-chairman, J. Chalmers; secretary-treasurer, C. A. Robb; executive committee, A. T. Fraser, D. J. Carter, J. L. Cote, D. Donaldson.

A number of the engineers present spoke briefly alluding to the large number of the members who had enlisted in the service of King and Country, the signs of returning business activity in the west, the great undeveloped resources, the revival of development work following the close of the war, and the consequent demand for qualified civil engineers. After the disposal of other regular business brought before the branch, the meeting adjourned at 9.30 o'clock.

Personal

Mr. W. S. Robertson has resigned his position as general manager of the Electric Power Company recently taken over by the Ontario Government, and goes to the United States to accept a responsible position.

Mr. Andrew F. Macallum, for many years city engineer of Hamilton, has been appointed Commissioner of Works of the city of Ottawa.

Mr. A. F. Macallum, recently appointed Commissioner of Works, Ottawa.

Mr. L. G. Ireland, local manager of the Brantford Hydro-electric Commission, has been appointed engineer to the Hydro-electric Power Commission of Ontario, in charge of the lines in the Trent Valley area recently taken over from the Electric Power Company.

Mr. L. G. McNeice has been appointed general manager of public utilities of the town of Wallaceburg. Mr. McNeice formerly represented the consulting engineering firm of Chipman & Power, Toronto, in the city of London, and more recently was engineer-in-charge for them in the installation of the waterworks and sewage systems at Wallaceburg. He is a science graduate of Queen's University.

Canadians who have gained distinction in professional and educational work were given honorary degrees by the University of Toronto at Convocation on Friday. Amongst those who were honored were Mr. Frank Darling, one of Toronto's best known architects, and Prof. Frank D. Adams, Ph.D., D.Sc., F.R.G.S., F.R.S., of McGill University, who is widely known as a geologist and educationalist, and past-president of the Canadian Mining Institute, International Congress of Geologists, the Montreal Natural History Society, and the McGill Graduates' Society.

Under the terms of a new by-law, Howard Ferguson has been appointed building inspector at Trail, B.C., and applications for permits for repairs, alterations, or new structures of any kind, must in future be referred to him.

Obituary

The death is announced of Mr. A. N. Mungall at his home at Fredericton, N.B. Mr. Mungall was a young man, only 28 years of age. He had followed the occupation of civil engineer for a number of years, and was engaged in the construction of the National Transcontinental and other lines.

Mainly Constructional

East and West—From Coast to Coast

Reciprocity with the State of Michigan takes effect on May 25.

The Canadian Drawn Steel Co., Ltd., Hamilton, Ont., have taken out a charter.

The Canada Forge Company will make a $50,000 addition to their plant at Welland Ont.

The planing mill of Lewis Fick & Son, at Guelph, Ont., was recently destroyed by fire.

J. H. Sticht & Company, manufacturers of ornamental iron, Longueuil, Que., have registered.

The Trades and Labor Council of London, Ont., propose to build a temple in that city, to cost about $45,000.

There were 29 building permits issued at Waterloo, Ont., for the month of April, representing a value of $48,495, a decrease from the same period last year of $9,330.

Satisfactory progress is being made on the site of the G.N.R. depot at False Creek, B.C., and it is expected that work on the superstructure will commence shortly.

Arrangements were completed with reference to the interchange of motor licenses between Ontario and the State of New York, and became effective on the 20th inst.

Building permits to the value of $20,086 were issued at Welland, Ont., during the month of April this year, as compared with $55,032 during the same period last year.

The value of the building permits issued in Guelph, Ont., during the month of April is $21,812. This makes a total value of the permits for the first four months of the year $24,227.

There is a rumor that the Crown Portland Cement plant at Wiarton, Ont., may be sold, and that instead of cement will be manufactured magnesia, hydrate of lime, potash, etc.

A by-law will shortly go into effect in Westmount, Que., authorizing the formation of an architectural commission to supervise the outside design and construction of buildings, public and private.

The Dominion Government is taking no action as regards the Daylight Saving scheme. Premier Borden states that he thinks it is better for the municipalities to deal with the matter for the present at least.

The Department of Public Works of Ontario has approved of a plan to expend $145,000 during the present year on additional good roads in York County, 40 per cent. of the cost of which the Provincial Government pays.

The number of building permits issued in the city of Hamilton, Ont., for the first four months of this year was 205, amounting to $451,700, as compared with 163 during the same period in 1915, representing a value of $387,183.

The Council of Esquimault, B.C., is taking proceedings against Thomas E. Young, contractor, to recover some $5,000 which, it is alleged, was overpaid him by last year's Council for excavation and other work in connection with sewer contracts.

It is stated that the Canadian steel companies have contracted so far ahead that they cannot now accept orders except for delivery in the far-away future, and that as a result of this unusual activity they are all showing very large earnings.

Mr. Paul Janoushevsky, of the Vladicaucase Railway, Russia, has been visiting Vancouver, B.C., and Portland, investigating the construction of bridges. On his return to Russia he will superintend the construction of the first direct lift bridge to be erected in that country.

The work on the big Centre street reinforced concrete bridge at Calgary, Alta., is progressing satisfactorily. The first two spans are practically completed, and the false work for the third is being set up. It is estimated that the bridge will be open to traffic before the end of the year.

The amount of the building permits issued in Chatham, Ont., during April this year, was $23,570, as compared with $13,200 in April, 1915. The total value of the permits issued for the first four month of the year was $40,120, a decrease of $12,280 from the same period last year.

The first steel rolling mill in the Province of British Columbia recently started operations at Port Moody. The mill when completed will be in two units, but only one of them has been erected as yet. The new concern is under the presidency of Mr. E. Francis.

Work on the aqueduct of the Greater Winnipeg water district has been resumed. Construction had been stopped, owing to the belief that the condition of the soil possibly did not warrant the pouring of concrete according to the original design. The design has been slightly changed.

By-laws were carried recently by the Council of York Township, Ont., providing for the raising of sums aggregating nearly $55,000, to cover improvements made last year. The work, which consisted of the laying of concrete sidewalks, sewers and cement roadways, was the most extensive ever carried out in York Township.

G. N. Hatfield, road engineer, in an interesting paper read before the Rotary Club at St. John, N.B., outlined plans for building a 215 mile highway from St. Stephen through St. John and Moncton to the border of Nova Scotia, using part of the revenue from automobile licenses for carrying out the work. The club approved the plan.

The work on the construction of Welland ship canal for which contracts have been given out, is progressing favorably, according to a statement made by Chief Engineer Weller, and all indications are that with the exception of the Thorold section, where considerable blasting had to be done, operations will be completed on schedule time.

Tenders are being called in East Trail, B.C., for the construction of one mile of road and the laying of over 8,000 feet of mains which were recently purchased in Vancouver for a proposed water system. A reservoir is to be situated at an elevation of about 200 feet above the townsite, and the water will be impounded about one mile up Randall Creek. J. D. Anderson is looking after the installation for the owners, McKelvey & Randall.

Proposals were made by a Niagara Falls deputation recently received by Hon. Mr. Reid, Acting Minister of Railways and Canals, that the dam and lock, which it was intended to place at Port Robinson in order to raise the Welland river to the level of the canal, should instead be placed at Montrose, and also that the proposed power canal be made a ship canal from its intake at Montrose to a point south of Lundy's Lane, in the Township of Stamford.

The plans of the new Parliament Buildings at Ottawa, as drafted by Architects Pearson, of Toronto, and Marchand, of Montreal, have been under consideration by the Commission of both Houses, and it has apparently been decided to add a fourth storey to the building. The additional cost of the enlargement will probably be something over $1,000,000. According to preliminary estimates the expenditure on the completed structure will be nearly $5,000,000.

The Winnipeg City Council have given permission to the Grain Exchange to make an addition of three stories to their building, to cost some $150,000. The architects are Over & Jordan, Winnipeg. The Council have also ratified an agreement with St. Boniface, by which the construction of the superstructure of the Provencher bridge will be erected as soon as possible. The total cost of the bridge is estimated at about $591,000, of which St. Boniface is to pay two-thirds.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Markham, Ont.
The Village Council are calling for new tenders on the construction of about 35,000 square feet of concrete sidewalk, the first tenders being unsatisfactory. Clerk, M. White.

Montreal, Que.
The City Council propose to expend about $250,000 on the construction of asphalt and block pavements, and will call for tenders. Engineer, P. Mercier.

New Waterford, N.S.
Tenders are now being received for the construction or sewers, curbs, and gutter for the Town Council, estimated to cost $5,000. Engineer, G. J. Ross, Sydney, N.S. Closing date about June 20th.

Orford Township, Ont.
The Township Council are considering the construction of an open ditch drain, estimated to cost $4,454. Engineer, J. A. Macdonald, Ridgetown, Ont.

St. Catharines, Ont.
Tenders will be received until 5 p.m., June 1st, by the Chairman of the Board of Works, for the construction of about 5,200 feet of trunk sewer. Engineer, W. P. Near.

St. John, N.B.
The City Council are considering the construction of extensions to the waterworks system, ot an approximate cost of $230,000.

Toronto, Ont.
Commissioner of Works, R. C. Harris, has recommended the following work:—Sewers, $46,100; granite block paving, $31,697; brick block paving, $4,533; asphalt paving, $5,653; concrete sidewalk, $3,020; concrete paving, $7,700.

The York County Highways Commission propose to spend $140,000 on the improvement of roads throughout the county, and the scheme has been approved by the Provincial Government. Engineer, E. A. James, 57 Adelaide Street E.

CONTRACTS AWARDED

Humboldt, Sask.
The contract for the construction of a reservoir for the Town Council has been awarded to the Northern Construction Company, Saskatoon, at $3,880.

Laval, Que.
The contract for the construction of macadam roads for the Town Council has been let to A. T. A. Chagnon & Fils, Laprairie Village. Approximate cost, $7,000.

New Hamburg, Ont.
The Town Council have awarded a contract for the construction of reinforced concrete pavement and curbing to E. J. Holland, Ingersoll. Approximate cost, $15,000.

Windsor, Ont.
The City Council have let a contract for the construction of a quantity of concrete pavement to the Chick Contracting Company, McDougall Ave. Approximate cost, $7,500.

Railroads, Bridges and Wharves

MooseJaw, Sask.
The City Council are considering the construction of a pole dam across the valley of Thunder Creek. Engineer, George D. Mackie.

South Dumfries Township, Ont.
Tenders on the constduction of a steel and concrete bridge will be received until June 5th by the Township Clerk, Henry Maus, Paris. Engineers, Jackson & Lee, Temple Building, Brantford.

Upper Jemseg, N.B.
Tenders on the construction of bridge superstructure and approaches will be received until noon, May 31st, by Hon. John Morrissy, Department of Public Works, Fredericton. Plans and specifications at Provincial Rooms, St. John, at office of H. W. Woods, Esq., Welsford, with Slocum & Townes, Jemseg, and at the Department.

Waneta, B.C.
The Provincial Department of Public Works, Victoria, have had plans prepared for the construction of a bridge over the Pen d'Oreille River, at an approximate cost of $15,000. Engineer, Thomas Kilpatrick, Victoria.

CONTRACTS AWARDED

Sunbury County N.B.
The Provincial Department of Public Works, Fredericton, have awarded the contract for the construction of a bridge at Black Creek Mouth to Luther B. Smith, 38 Dufferin Road, St. John, N.B.

Public Buildings, Churches and Schools

Calgary, Alta.
The School Trustees propose to build two manual training buildings at an estimated total cost of $56,000, and will submit a by-law.

The erection of an auditorium at an approximate cost of $150,000, is being considered, and a special committee has been appointed, of which City Engineer Craig is a member.

Casselman, Ont.
Charles Brodeur, Architect, 63 City Hall Street, Hull, Que., has prepared plans for alterations and additions to the Parish Church, estimated to cost $6,500. Tenders will be called shortly. Frame and brick veneer construction.

Gravenhurst, Ont.
The National Sanatarium Association, 223 College Street, Toronto, propose to construct a central heating plant, a vocational building and a number of cottages at the Hospital. Architect, C. S. Cobb, 71 Bay Street, Toronto.

Hespeler, Ont.
Sketch plans are being prepared for a Roman Catholic Church, to be built on Cooper Street at an approximate cost of $10,000. Architect, J. M. Cowan, 65 Adelaide Street E., Toronto.

London, Ont.
Tenders on the erection of a Technical School will be received until June 3rd by A. E. Silverwood, Chairman of the School Board. Architects, Watt & Blackwell, Bank of Toronto Building. Estimated cost, $200,000.

Nelson, B.C.
Plans are being prepared for the erection of a building for the Kootenay Lake General Hospital. Estimated cost, $50,000.

Orillia, Ont.
Bulk of separate tenders on the erection of an addition to the General Hospital will be received until noon, May 27th, by George Thompson, Chairman of the Building Committee. Plans and specifications at office of G. H. Clark, and with the Architect, W. H. Croker, Atherley Street. Estimated cost, $10,000.

Tenders on plumbing, heating, wiring, and roofing required in connection with the erection of the Municipal Building are being received by the Clerk, C. E. Grant, and the Architects, Burke, Horwood & White, Ryrie Building, Toronto.

Ottawa, Ont.
Charles Brodeur, Architect, 63 City Hall Street, Hull, Que., is preparing plans for the erection of a dormitory and laundry in connection with the Water Street Hospital. Tenders will be called in about one month. Approximate cost, $28,500.

Sherbrooke, Que.
The contract for heating required in connection with St. Michael's Cathedral will be let by F. M. Hoadley & Company, 58 Beaver Hall Hill, Montreal. Roofing contract has not yet been let.

Vancouver, B.C.
The Department of Public Works, Ottawa, are now receiving tenders on the removal of the existing buildings preparatory to the erection of a Postal Station at an approximate cost of $124,000. Secretary, R. C. Desrochers, Ottawa.

Weston, Ont.
C. S. Cobb, Architect, 71 Bay Street, Toronto, is preparing plans for a Children's Cottage to be built for the National Sanitarium Association, 223 College Street, Toronto.

CONTRACTS AWARDED

Cartierville, Que.
In connection with the church basement now in course of erection for the Roman Catholic Congregation, the plastering has been let to F. Beaudoin & Fils, 636 Drolet Street, Montreal, and

the painting to Charles Larin, 468 Parc Lafontaine, Montreal.

Medelec, Que.
The general contract for the erection of a school has been let to Alphonse Robert, Nord Temiscamingue. Approximate cost, $4,500.

Montreal, Que.
In connection with the school and residence now being built for the Commissioners of Cate des Nieges, the roofing contract has been awarded to the Standard Roofing Company, 189 McCord Street.

Repentigny, Que.
The contract for mill work required in the erection of a school for the Roman Catholic School Board has been awarded to F. Limoges, Terrebonne.

St. Antoine de Bienville, Que.
The contract for plastering at the Parish Church has been let to Paquet & Godbout, 21 William Street, St. Hyacinthe.

St. Celestin, Que.
The general contract for the erection of a hospital for the Grey Nuns of St. Celestin has been awarded to Louis Caron & Fils, Ltd., Nicolet. Approximate cost, $18,000.

St. Christophe Pont Viau, Que.
The general contract for the erection of a Chapel and Parsonage for the Parish has been awarded to Blais & Lemieux, Ahuntsic, Que. Approximate cost, $13,500.

Business Buildings and Industrial Plants

Banff, Alta.
Tenders on labor only required in the erection of a business block for R. G. Brett will be received until noon, June 1st. Plans and specifications with J. D. Hansen and the Architect. Estimated cost, $20,000.

Burford, Ont.
The Canadian Milk Products Company, Mail Building, Toronto, propose to build a plant, at an estimated cost of $100,000. Previously reported as being at Listowel.

Carlton Point, P.E.I.
Tenders on the construction of a station, water tank, engine house, transfer platform, standpipe pit and turntable, will be received until noon, May 31st, by J. W. Pugsley, Department of Railways and Canals, Ottawa. Plans and specifications with the Engineer, Car Ferry Terminals, the Chief Engineer, Moncton, N.B., and at the Department.

Chatham, Ont.
The American Pad & Textile Company, Queen Street, propose to build an addition to their premises, at an approximate cost of $30,000.

Markham, Ont.
A Company is being formed to erect a flour mill at an approximate cost of $60,000.

Merlin, Ont.
James T. Mason has commenced the erection of an addition to his store and residence, estimated to cost $3,000. Frame, white brick, and concrete construction.

Moncton, N.B.
J. D. Creaghan Company are considering the erection of an addition to their store, estimated to cost $4,000.

Montreal, Que.
The Canadian Tube & Iron Company, Ltd., 107 Hamilton Street, have commenced the erection of a factory, estimated to cost $3,000. Brick and concrete construction.

Tenders are now being received for roofing, heating, plumbing, and electrical work required in the erection of an addition to the premises of the Canadian Consolidated Rubber Company, Ltd.

Newbury, Ont.
R. Winship is building a residence and barn, estimated to cost $3,000. Frame and concrete construction.

Ottawa, Ont.
Tenders on the erection of a factory for Grant, Holden & Graham, are being received by the Architect, James Mather, 110 Wellington Street. Brick construction. Approximate cost, $30,000.

Port Dover, Ont.
Buck Brothers are having plans prepared for a Casino, estimated to cost $10,000.

Quebec, Que.
Bedard & Kippan, 12 Cartier Avenue, are having new plans prepared for the theatre which they propose to build on St. John Street. Architect, A. G. Nosworthy, Quebec Railway Building. Estimated cost, $6,000.

Renfrew, Ont.
The Renfrew Electric Manufacturing Company, Ltd., have commenced the erection of an addition to their premises, estimated cost of $5,000. Brick and concrete construction.

The Renfrew Curling Club contemplate the erection of a rink, at an approximate cost of $7,000. Secretary, R. D. Scott. Brick and concrete construction.

Simcoe, Ont.
The Hall Glove Company, Jersey City, N.Y., propose to build a textile factory, at an approximate cost of $25,000. Particulars from Charles Philip, 52 Bay Street, Toronto.

St. Thomas, Ont.
A. S. Smith, Palace Livery, propose to build an office building, and will prepare plans. Estimated cost, $7,000.

Tilbury, Ont.
Plans are to be prepared immediately for a station to be built for the Michigan Central Railway, at an approximate cost of $6,000. Brick construction. Superintendent, F. Williams, M.C.R., St. Thomas.

Toronto, Ont.
The McClary Manufacturing Company, 177 King Street W., have started work on an addition to their warehouse, estimated to cost $3,500. Brick construction.

G. I. Hambly, 372 St. Clarens Avenue, is building a pair of store and apartments at St. Clair Avenue and Kennedy Street, estimated to cost $6,000. Smaller trades will be let. Brick construction.

Eustace G. Bird, 6 King Street W., has been appointed Architect for the proposed store to be built for Murray-Kay, Ltd., 17 King Street E. Steel, terra cotta, and brick construction.

Vancouver, B.C.
Plans have been prepared for the erection of a garage for the British Columbia Sugar Refinery Company. Reinforced concrete construction. Approximate cost, $9,000.

The Canadian Northern Railway propose to build a large hotel, and have secured an option on a site.

Victoria Park, Ont.
The Michigan Central Railway propose to build a large frame storehouse, at an approximate cost of $7,000. Superintendent, F. Williams, St. Thomas, Ont.

Weston, Ont.
Work is about to start on the erection of a factory for T. A. Russell, c/o. the Russell Motor Company, King and Duncan Streets, Toronto. Steel and brick construction.

Windsor, Ont.
Walker & McPhail, Architects, Tuson Building, are preparing sketch plans of a store to be erected on Ouellette Avenue, for a Syndicate. Steel, brick, and concrete construction. Approximate cost, $20,000.

CONTRACTS AWARDED

Brantford, Ont.
In connection with alterations to the premises at 30 Market Street, for W. T. Jones, the contract for heating and plumbing has been let to T. J. Minnes & Company, 9 King Street, and the electrical work to Fred Webster, 211 Colborne Street.

Halifax, N.S.
The general contract for alterations to a restaurant building for Bonds Ltd., Barrington Street, has been let to the Eastern Investment Corporation, Ltd., Cragg Building. Approximate cost, $20,000.

Harrow, Ont
The general contract for the erection of a factory for the W. Clark Company, Ltd., 83 Amherst Street, Montreal, has been let to Munn & Shea, 6 Cuthbert Street, Montreal. Estimated cost, $15,000.

Kingston, Ont.
The general contract for the erection of a storehouse for the Frontenac Moulding & Glass Company, Kingston Junction, has been awarded to Charles Hermiston, 84 Collingwood Street. Approximate cost, $5,000.

London, Ont.
The general contract for the erection of an addition to the premises of E. Leonard & Sons, York Street, has been awarded to John Hayman & Sons, Wellington Street. Brick and concrete construction. Estimated cost, $8,000.

The contract for stone work required in alterations to a store for Miss F. Mitchell, 114 Dundas Street, has been let to Nobbs Brothers, C.P.R. and William Street, and the plumbing to F. C. Hunt, Richmond and Kent Streets.

Maisonneuve, Que.
The general and masonry contracts for the erection of an addition to the premises of the Montreal Last Company, 562a LaSalle Avenue, have been awarded to L. Labrecque, 422 Parc Lafontaine Street, and the roofing, heating and plumbing to J. E. Hardy, 666 Papineau Avenue.

Melbourne, Ont.
The general contract for the erection of a residence and barn for James Carrothers has been let to Watson & Mc-

Tenders and For Sale Department

TENDERS

For the erection of the New Technical and Art School on Dundas Street in the City of London, sealed tenders are invited, bulk and separate for all trades, except the heating and ventilating and wiring, for which separate sealed tenders must be submitted.

All tenders will be received not later than 12 o'clock noon on **Saturday, June the third, 1916**, at the office of the Secretary of the Board of Education at the City Hall.

A duly certified cheque for five per cent. of the amount of the bid must be enclosed with each tender. Plans and specifications may be viewed at the offices of the Architects, A. E. Nutter, Rooms 15-16, Dominion Bank Chambers, and Watt & Blackwell, Bank of Toronto Chambers.

Plans for heating and ventilating and wiring may be seen at the offices of the above Architects or at the office of H. P. Elliott, Heating Engineer.

The lowest or any tender not necessarily accepted.

A. A. LANGFORD,
Chairman of Industrial Advisory Committee.

R. M. McELHERAN,
Secretary Board of Education.

21-21

Tenders for Steam Turbine

Sealed tenders will be received up till 5 p.m., **Thursday, June 1st, 1916**, addressed to the City Commissioners, Weyburn, Sask., for the supply and erection of one 500 K.W. Steam Turbine, Generator, Switchboard and Auxiliaries.

All information may be had by applying at the above address.

The lowest or any tender not necessarily accepted.

DR. C. P. MOORE, Mayor.

GEO. V. REED, Commissioner. 20-21

Tenders for Sewers

Notice to Contractors

Order No. 1511

Sealed tenders will be received, addressed to the Chairman of the Board of Works, City Buildings, St. Catharines, Ont., up to 5 o'clock of **Thursday, June 1st, 1916**, for the construction of sewers of the following sizes:

144 ft. of 24-inch Cast Iron Outlet.
1,170 ft. of 72-inch Sewer.
2,800 ft. of 60-inch Sewer.
1,170 ft. of 54-inch Sewer.
with Manholes, Bellmouths, etc.

Plans, profiles and specifications may be seen at and form of tender obtained from the office of the City Engineer. Envelopes containing tenders must be plainly marked as to contents. All tenders must be accompanied by a marked cheque for five per cent. of the amount of the tender, together with the names of two personal sureties, or the name of a guarantee company approved by the City Treasurer. The lowest or any tender is not necessarily accepted.

W. P. NEAR,
City Engineer.

21-21

Tenders for Pavement

Tenders will be received by the undersigned up to **June 3rd, 1916**, for the construction of macadam pavement on Turnberry Street, Brussels. Plans and specificatioo in the hands of the Clerk after May 24th, 1916.

21-22 F. S. SCOTT, Village Clerk.

Canadian Pacific Railway Co.

North Toronto Grade Separation

Tenders will be received by the undersigned up to May 31st, 1916, for the purchase and removal of the old Canadian Pacific Railway North Toronto Station Building.

Proposal forms and other information may be obtained at the office of the undersigned, 262 Avenue road, Toronto.

No tender necessarily accepted.

B. RIPLEY,
Engineer of Grade Separation.
19-

Tenders for Dredging

Sealed tenders, addressed to the undersigned and endorsed "Tender for Dredging, Port Maitland," will be received at this office until 4 p.m., on **Tuesday, May 30, 1916**, for dredging required at Port Maitland, Ontario.

Tenders will not be considered unless made on the forms supplied, and signed with the actual signatures of tenderers.

Combined specification and form of tender can be obtained on application to the Secretary, Department of Public Works, Ottawa. Tenders must include the towing of the plant to and from the work.

The greater portion of this work will be required to be done by an hydraulic dredge.

The dredges and other plant which are intended to be employed on this work shall have been duly registered in Canada at the time of the filing of the tender with the Department, or shall have been built in Canada after the filing of the tender.

Contractors must be ready to begin work immediately upon notification of the acceptance of their tender.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, for five per cent. (5 p.c.) of the contract price, but no cheque to be for less than fifteen hundred dollars, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, May 19, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 21-21

Tenders for Bridge Abutment

Sealed tenders, addressed to the County Clerk, Owen Sound, will be received by the Chairman, Road & Bridge Committee of the County of Grey, up to 6 p.m., **Saturday, the 27th day of May, 1916**, for the construction of a Bridge Abutment of Cement-Concrete at the Rocky Saugeen River, 4 miles north of Durham.

A marked bank cheque, payable to the Treasurer, County of Grey, for 5 per cent., shall accompany each tender, and will be returned upon non-acceptance.

Plans and specifications may be seen at the Clerk's or Engineer's offices.

The lowest or any tender not necessarily accepted.

FRED. RUTHERFORD,
County Clerk.

R. McDOWALL, C. E.,
County Engineer.

20-21

Concrete Bridges

Sealed tenders will be received by R. R. Hambly, Esq., Postmaster, Drayton, up to 10 a.m., on **Friday, June 2nd**, for the construction of the following concrete bridges for the County of Wellington:

Three concrete arched trusses of 70 ft., 40 ft, and 35 ft. spans and a 24-ft. beam bridge.

For plans and other information, apply to

BOWMAN & CONNOR,
31 Queen St. W., Toronto.

48-48

Concrete Bridges

Sealed tenders will be received by Jas. Beattie, Esq., County Clerk, Fergus, up to 2 p.m. on **Thursday, June 1st**, for the construction of the following concrete bridges for the County of Wellington:

Four concrete arched trusses of 70 ft., 65 ft., 60 ft. and 30 ft. spans, and two 14-ft. slab bridges.

For plans, specifications and estimate of quantities, apply to

BOWMAN & CONNOR,
31 Queen St. W., Toronto.

48-48

Concrete Bridge

Sealed tenders will be received by W. W. Scott, Esq., Moorefield, up to 10 a.m. on **Saturday, June 3rd**, for the construction of a 24-ft. concrete bridge and a culvert for the Township of Maryboro. For plans, etc., apply to

BOWMAN & CONNOR,
31 Queen St. W., Toronto.

48-48

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

Lellen, Strathroy, Ont. Frame and concrete construction. Estimated cost, $3,800.

Moncton, N.B.
T. D. LeBlanc, Lakeburn, Moncton, has commenced the erection of two stores and residences for the City Land Investment Compony. Stone and steel construction. Approrimate cost, $5,400.

Niagara Falls, Ont.
The contract for plumbing and heating required in additions to the Bank of Hamilton, Queen Street, has been awarded to Cole & McMurray, Park Street. Masonry, carepntry and steel work by owners.

Ocean Falls, B.C.
The contract for supply of reinforcing steel and cement required in the erection of mills for the Pacific Mills, Ltd., 808 Standard Bank Building, Vancouver, has been awarded to Balfour, Guthrie & Company, 739 Hastings Street W., Vancouver.

Ottawa, Ont.
In connection with the erection of a rink on Argyle Street, the contract for carpentry has been let to J. & C. Low, Catherine Street.

The contract for painting in connection with the erection of club rooms for the Y.W.C.A., has been let to Higman & Son, 176 Rideau Street, and the electrical work to Charles Presby, 138 Irving Street. Brick work and masonry by general contractor.

E. Goodall, 305 Wellington Street, has awarded the contract for the erection of a kitchen and garage to R. E. McKinstrey, 91 Second Avenue. Brick veneer construction. Estimated cost, $3,500.

Quebec, Que.
The general contract for the erection of a warehouse for E. Latour, 199 Canardiere Road, has been awarded to J. Gravel, 106 Fifth Street, Limoilou. Approximate cost, $6,000.

St. Laurent, Que.
The general contract for the erection of an office building and other extensions for the Canada Stove & Furniture Company, Ltd., has been let to F. A. Grothe, 6 Ste. Cuthbert Street, Montreal. Approximate cost, $60,000.

Toronto, Ont.
The general contract for the erection of an addition to the factory of the Sheet Metal Products Company of Canada, Limited, 199 River Street, has been awarded to Brown & Cooper, 297 Carlton Street. Steel and brick construction. Approximate cost, $6,000.

The general contract for alterations to a theatre for E. L. Ruddy et al, 11 Wellington Street E., has been awarded to the Jackson Lewis Company, Limited, Bell Telephone Building. Approximate cost, $75,000.

In connection with the erection of a factory at Teraulay and Alice Streets for the T. Eaton Company, the contract for excavation has been let to W. H. Thomson, 29 Marlborough Avenue.

The Board of Control have let the following trades contracts for the erection of a barn at the Jail Farm: carepntry, G. L. Robinson, 107 Armstrong Avenue; wiring, H. Alexander, 98 Bay Street; steel, McGregor & McIntyre, 1139 Shaw Street; sheet metal, W. E. Dillon, 183 George Street; painting, Cornelius & Company, 50 Walker Avenue; plumbing and heating, Bennett & Wright Company, 72 Queen Street E.; stable fittings, Superior Barn Equipment Company, Fergus, Ont.

Vancouver, B.C.
The following contracts have been let for the supplies required in the erection of a theatre for C. W. Bowman, Southampton, Ont.: common brick, McNeill, Welch & Wilson, 80 Pender Street E.; face brick, cement, and reinforcing steel, Evans, Coleman & Evans, 407 Granville Street; lumber, Cedar Grove Sash & Door Company, Spruce Street.

In connection with the erection of an addition to the premises of the American Can Company, the contract for heating and electrical work has been let to Carr Brothers, 1228 Granville Street.

The general contract for the erection of a station at False Creek for the Great Northern Railway has been let to Grant, Smith & Company, Pacific Building. The contractors are now receiving tenders on plumbing, electrical work, form lumber and stone.

Welland, Ont.
Louis Bunco has let the general contract for the erection of a store and bowling alley on South Main Street to William Mitchell, 120 Aqueduct Street. Brick and concrete construction. Approximate cost, $6,000.

The general contract for the erection of stores on Ontario Road for Walter Stayzer has been awarded to William Mitchell, 120 Aqueduct Street. Frame and concrete construction. Estimated cost, $12,000.

The Standard Steel Construction Company are building a factory warehouse for the Canada Forge Company, Ltd. Steel and brick construction. Estimated cost, $50,000.

Westmount, Que.
A. A. Larocque, 75 Common Street, has commenced the erection of a garage, estimated to cost $3,000, and has let the general contract to Laurent & Frere, 635 Papineau Avenue, and heating and plumbing to J. & C. Brunet & Company, 223 St. Lawrence Boulevard, Montreal. Owner will do masonry and interior fittings.

Winnipeg, Man.
The foundation work required in the erection of premises at Main and McDermot Streets for the Bank of Hamilton is being done by the Foundation Company of Canada, Ltd., Montreal and Winnipeg. Tenders will be called shortly for the erection of the building. Approximate cost, $600,000.

Residences

Atwood, Ont.
Mrs. Bertha Hanna proposes to build a residence on John Street, at an approximate cost of $3,000.

Belmont, Ont.
The erection of a residence is being considered by Cecil Barons. Estimated cost, $3,500.

Essex, Ont.
L. E. Barber proposes to build a residence on Talbot Street, at an approximate cost of $3,000, and will prepare plans.

Fergus, Ont.
T. J. Hamilton contemplates the erection of three residences, and will prepare plans. Approximate cost, $4,500.

Hamilton, Ont.
J. Dwyer, 55 East Bend Street, has commenced the erection of two residences, estimated to cost $4,000. Brick and concrete construction.

Lambeth, Ont.
Walker Finch is considering the erection of a bungalow, estimated to cost $3,500, and will prepare plans.

London, Ont.
A. E. Nutter, Architect, Dominion Bank Building, is preparing plans of four cottages, estimated to cost $8,000. Frame and concrete construction.

Mersea Township, Ont.
William Ross, Mersea Township, Cottam, has commenced the erection of a residence, estimated to cost $3,000. Frame and concrete construction.

Moncton, N.B.
A. J. Cormier is having plans prepared for two residences, to cost about $4,000 each. Architect, Albert Sincennes, 642 Main Street. Frame and brick construction.

Montreal, Que.
E. Ducharme, 734 Outremont Avenue, has commenced the erection of flats on Wolfe Street, estimated to cost $5,000, and is receiving tenders on plastering and electrical work. Brick construction.

J. B. Daoust, 46 Prudhomme Street, is building a residence on Addincton St., estimated to cost $3,700.

Montreal West, Que.
E. W. Barnes, Wolseley Avenue, is receiving tenders on brick work, terra cotta, mill work and red slate roofing required in the erection of a residence on Strathearn Avenue. Approximate cost, $8,500.

Ottawa, Ont.
W. H. Lee, 36 Barton Street, contemplates the erection of a residence, at an approximate cost of $1,000. Brick veneer construction.

Quebec, Que.
Lavoie & Frere, 56 Jeanne d'Arc St., have commenced the erection of a residence, estimated to cost $9,000. Frame and brick construction.

N. Poirier, 111 Third Avenue, has commenced the erection of a residence, estimated to cost $4,000. Brick construction.

Toronto, Ont.
Plans have been prepared for an addition to a residence for Mrs. D. Campbell, 35 Wilton Crescent. Brick construction. Estimated cost, $4,000.

C. Black, 230 Danforth Avenue, proposes to build a pair of residences on Greenwood Avenue, at an approximate cost of $3,000, and will let smaller trades.

William Davis, 3 Scarboro Road, has commenced the erection of a residence, estimated to cost $3,500. Smaller trades will be let. Brick construction.

W. Moad, 46 Oakwood Avenue, is building a duplex residence, estimated to cost $5,000. Smaller trades will be let. Brick construction.

A. A. Mitchell, 502 Palmerston Avenue, is building a four-apartment residence at Gormley and Lawton Streets, estimated to cost $10,000. Brick construction.

Work on the erection of a pair of residences has been started by J. Cooper, 51 Wilton Avenue. Brick and roughcast construction. Estimated cost, $3,000. Smaller trades will be let.

J. H. Stamford, 17 Westmoreland Avenue, has prepared plans of a duplex residence to be built for J. Craig, 626 Grace Street. Estimated cost, $3,800. Brick construction.

Tenders are being received by William Davies, 3 Scarboro Road, on plumbing, hot water heating and wiring in connection with the residence which he is building.

T. Robinson, 131 Glenholme Avenue, has commenced the erection of a pair of residences on Albertus Street, estimated to cost $5,000. Smaller trades will be let. Brick construction.

J. H. Stamford, 17 Westmoreland Avenue, has prepared plans of a duplex residence to be built for Mrs. Wilson, 26 Beach Avenue. Brick construction. Estimated cost, $4,500.

Vermont, Ont.
The report published under this head in our last issue is incorrect. The work mentioned is at Vermont, U.S.A.

Walkerton, Ont.
J. H. Ranesbottom proposes to build a residence at an approximate cost of $3,000, and will prepare plans. Brick construction.

Wheatley, Ont.
Thomas Liddle has commenced the erection of a residence on Moore Street. Frame, white brick and concrete construction. Estimated cost, $3,000.

Winchester, Ont.
Tenders on the erection of a residence for W. J. Fraser are being received. Architect, George Tomlinson, 246 First Avenue, Ottawa. Estimated cost, $10,000. Closing date, about May 29th.

Zion, Ont.
Lloyd Wharram, Wheatley, Ont., has commenced the erection of a residence, estimated to cost $3,000. Frame and concrete construction.

CONTRACTS AWARDED

Belmont, Ont.
The general contract for the erection of a residence for Adam Harkness has been let to F. McCann, Dorchester. Frame and concrete construction. Estimated cost, $3,000.

Brantford, Ont.
The contract for painting in connection with the erection of a residence for E. L. Goold, 103 Darling Street, has been let to Richard Chave, 17 Pearl Street.

The contract for electrical work required in the erection of a residence for J. H. Young, 86 Colborne Street, has been awarded to the general contractor.

The general contract for the erection of a residence for J. W. Porter, 42 Dalhousie Street, has been let to Thomas Harris, 291 Dalhousie Street. Brick construction. Approximate cost, $3,000.

Brigden, Ont.
The general contract for the erection of a manse for the Presbyterian Congregation has been awarded to D. P. Shaw. Approximate cost, $3,500.

Charlottetown, P.E.I.
Frank Hennessey, 149 Great George Street, has let the general contract for the erection of a residence to W. J. Hennessey. Frame construction. Approximate cost, $4,500.

The general contract, masonry, carpentry, roofing, plastering and interior fittings contracts for the erection of apartments for Ivan Y. Reddin have been awarded to Charles H. Coles, 96 Brighton Road. Tenders on painting, heating, plumbing and electrical work are now being received by Mr. Coles. Approximate cost, $8,000.

Dunville, Ont.
The general contract, masonry, carpentry, plastering and tile work required in the erection of a residence for George Biddell have been let to S. W. Lymburner, heating and plumbing to Frank Haney and electrical work to James Smithers. Approximate cost, $12,000.

Dutton, Ont.
William Saunders, Dutton, has been awarded the general contract for the erection of a brick residence, estimated to cost $3,500.

Erin, Ont.
The contract for carpentry required in the erection of a residence for J. Coke has been awarded to the Erin Planing Mills Company. Other work by day labor.

Hamilton, Ont.
T. Lyon, 63 Wentworth Street West, has let the general contract, masonry, carpentry and roofing for the erection of two residences to J. W. Boyd, 125 Sanford Street N. Brick construction. Estimated cost, $3,200.

In connection with the erection of a residence for F. T. Smye, 222 Herkimer Street, the general contract, masonry and carpentry have been let to William Yates, 24 Leeming Street, roofing to T. Irwin, 22 McNab Street, plastering to Hannaford Brothers, 232 Robinson Street, painting to Smith & Omand, 179 Walnut Street S., heating and plumbing to Adam Clark, 7 Main Street W., and electrical work to Culley & Breay, 27 King Street W. Approximate cost, $15,000.

London, Ont.
The general contract for the erection of two residences for F. B. Kilbourn, 11 Cowe Road, has been awarded to S. H. Kilbourne, 42 Bruce Street. Brick construction. Approximate cost, $3,600.

J. A. McDonald has commenced the erection of a residence for D. Graham, 3 Perry Street. Brick construction. Estimated cost, $3,000.

Montreal, Que.
The general contract for the erection of a residence for A. Germain, 101 Rachel Street, has been let to Joseph Martel, 2477 St. Andre Street. Brick construction. Estimated cost, $3,000.

The following contracts have been let in connection with the residences now being built by J. B. Daoust, 468 Prud-h'omme Avenue:—brick work and masonry, C. Lefrancois; concrete work, A. Ladouceur, 40 St. Alphonse Street; roofing, F. X. Goudreau, 255 Visitation St.; plastering, Z. Bouchard, 12 Bourget St.; painting, W. D. Rufiage, 91 Rose de Lima Street; heating and plumbing, J. A. Hamelin, 922 Charlevoix Street; electrical work, Vallee & Hamlin, 1867 St. James Street; mantel and tile work, R. S. Muir & Company, 32 Park Avenue.

The following contracts have been awarded in connection with additions to the residence of the Ste. Elizabeth Society, 29 Seymour Avenue:—masonry, J. A. Charette, 142 St. Ferdinand Street; roofing, heating and plumbing, Ducharme, Blais & Company, 1995 St. James Street; plastering, Z. Bouchard, 12 Bourget Street; painting, B. Navert, 1229 St. Denis Street; electrical work, J. A. Hamelin, 922 Charlevois Street.

The contract for foundations and masonry required in connection with the flats now being built by J. St. Pierre, 105 St. Luke Street, has been let to Corbeil & Frere, 1862 Clarke Street. Tenders are now being received for roofing, plastering and electrical work. Approximate cost, $41,000.

Montreal West, Que.
The general contract for the erection of a residence for R. A. Brook, 136 Ballantyne Avenue S., has been let to E. W. Barnes, Wolseley Avenue. Approximate cost, $6,000. Sub-tenders on roofing, electrical and mill work are being received by the general contractor.

Ottawa, Ont.
A. E. Shaver, 45 Powell Avenue, has let the contract for heating and plumbing required in connection with the residences which he is building to J. T. Blyth, Frank Street.

The general contract for the erection of a residence for A. Crowson, 275 Arlington Avenue, has been awarded to W. G. Adamson, 12 Sparks Street. Brick veneer and stucco construction. Approximate cost, $3,800.

The general contract for alterations to apartments for P. J. Nolan, 673 Wellington Street, has been awarded to Alexander & Campbell, 245 Bank Street. Brick veneer construction. Approximate cost, $5,000.

The general contract for the erection of apartments on Laurier Avenue for James Neville has been let to H. P. Beck, 126 Sparks Street. Estimated cost, $12,000.

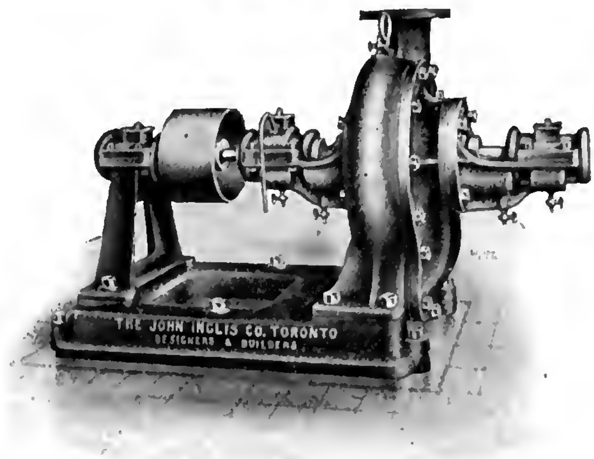
Oxford West Township, Ont.
The contract for masonry required in the erection of a residence for George Cook, Beachville, has been let to the McKenney Lumber Company, Woodstock, and carpentry to J. G. Coulter, Woodstock.

Quebec, Que.
Louis Matte, 189 St. Olivier Street, has let the general contract for an addition to his residence to J. Savard, 218 Richelieu Street. Frame and brick construction. Estimated cost, $3,000.

The general and masonry contracts for the erection of residences for Gordon and Ernest Ross have been awarded to A. Fackney, 107 St. Jocahim Street. Brick and concrete construction. Approximate cost, $9,000 each.

The general contract for the erection of a residence for J. E. Rouillard, 30 Maisonneuve Avenue, has been let to E. Peletier, 70 St. Cyrille Street. Brick and

PUMPS



Horizontal Belt Driven Turbine Pump supplied the University of Toronto.

This Pump is hydraulically balanced against end thrust and in addition has a water cooled thrust Bearing. The Pump is arranged so that it may be operated with guide vanes or without for demonstration purposes. Oil rings, Hydraulic Balance and water cooled thrust bearings are standard for all "Inglis" Turbine Pumps. We make pumps of all kinds for any service.

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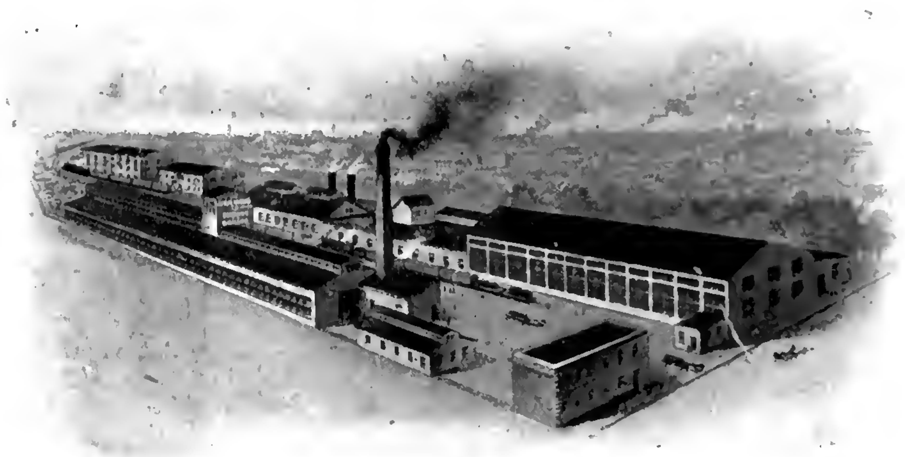

Plant of John Inglis Co., Limited, Toronto

The John Inglis Company, Limited

ENGINEERS AND BOILERMAKERS

14 Strachan Ave., Toronto, Canada

Ottawa Representative:—J. W. ANDERSON, 7 Bank Street Chambers concrete construction. Estimated cost, $7,000.

In connection with the residence now being built for G. Lepine, 281 St. Valier Street, the contract for roofing has been let to N. Barbeau, 36 Bridge Street, and heating, plumbing and electrical work to Jobin & Paquet, 78 Cote d'Abraham Street.

Sorel, Que.
The general contract for the erection of four flats for L. S. Robitaille, Phipps Street, has been awarded to Gendron & Bernard, at $7,000. Brick veneer construction.

Toronto, Ont.
In connection with the erection of a residence and garage for C. James, Nanton Court Apartments, the carpentry has been awarded to T. Frost, 169 Bellefair Avenue, and heating to R. Trickey.

W. B. Charlton, 412 Indian Road, has been awarded the general contract for the erection of a residence for J. Price, 134 Lee Avenue. Brick construction. Approximate cost, $3,500.

T. Robertson, 89 Elm Avenue, is building an addition to his residence, and has let the contract for masonry to Hugh Walker, 32 Guelph Avenue, and the carpentry to W. T. Kendall, 434 Sackville Street. Approximate cost, $5,000.

The contract for masonry and carpentry required in the erection of a residence for D. C. Cotton, 54 Adelaide St. E., has been awarded to A. Russell, 490 Delaware Avenue.

Work has started on the erection of a residence on Dunvegan Road for Mrs. T. Langton, care of W. A. Langton, 38 North Street. The masonry contract has been let to H. N. Dancy & Son, C. P. R. Building. Approximate cost, $15,000.

H. A. Johnson, 63 Normandy Boulevard, has commenced the erection of a residence on Benlamond Avenue for A. Con Record gal S1X ... Coulthard K. Gregory. Smaller trades will be sublet. Approximate cost, $4,000.

Windsor, Ont.
The general contract for the erection of a residence for S. E. Rigg, Pitt Street E., has been awarded to J. R. Sculland, Tuson Block. Brick and stucco construction. Approximate cost, $3,500.

Woodstock, Ont.
The contract for masonry required in the erection of a residence for R. W. Brink, care of B. McNichol, Architect, Mary Street, has been let to H. Buck, and the carpentry to T. D. Broom & Son, 18 Wilson Street. Approximate cost, $4,000.

Power Plants, Electricity and Telephones

Ingersoll, Ont.
The Town Council are about to proceed with the installation of an ornamental lighting system on King and Thames Streets. Clerk, W. R. Smith.

Prince George, B.C.
The City Council contemplate the installation of a power plant and may call for tenders shortly. Clerk, J. A. Turner.

Fires

Allanburg, Ont.
Residence of James Doherty totally destroyed.

Ottawa, Ont.
Warehouse owned by the Cousins Estate, care of Ottawa Realty Company, Castle Building, Ottawa. Loss, $3,500. Owners will rebuild.

Residence of L. Jolicoeur, Beechwood Avenue. Loss, $3,000.

Puslinch Township, Ont.
Residence owned by George Elliott, Hespeler. Loss, $3,000. Owner may rebuild.

Quebec, Que.
Chateau Frontenac, owned by the Canadian Pacific Railway, damaged to the extent of $25,000. Repairs started.

Store owned by Lockwell & Leclerc, 88 St. Peter Street. Loss, $20,000. Owners will rebuild.

Springfield, Ont.
Barn owned by Hiram Brooks completely destroyed. Loss, $3,200. Owner will rebuild in fireproof construction.

St. Elie, Que.
Roman Catholic Church and Presbytery. Loss, $40,000. May be rebuilt. Curate, Rev. M. de Beauport.

Stoney Creek, Ont.
Three barns belonging to Orville Quigley, Saltfleet Street, Hamilton. Loss, $10,000.

Miscellaneous

Angus, Ont.
The Department of Militia are constructing roadways, water supply system and sundry buildings at the Camp. Work is under supervision of Lieut. J. S. McMurray, Headquarters, Niagara Camp.

Ottawa, Ont.
The Secretary to the Board of Control will receive tenders until May 30th on the supply of 900 feet of wire cable, one 5-7½ h.p. Wagner centuary motor and one centrifugal pump. Specifications at office of the City Engineer.

Outremont, Que.
Tenders on the supply of materials required in constructional works during the season are now being received by the City Engineer, J. A. Duchastel de Montrouge.

Simcoe, Ont.
L. Fick & Son will require the following machinery in connection with the rebuilding of their planing mill:—planer, sticker, re-saw, rip table, shafting and belting, one 40 h.p. motor.

Winnipeg, Man.
The Chairman of the Board of Control will receive tenders until 10 a.m. June 5th for the supply of one combination gasoline-driven pumping engine and hose wagon, with a capacity of 700 gallons per minute.

CONTRACTS AWARDED

Windsor, Ont.
The City Council have awarded the contract for the supply of fire fighting equipment to the Menard Motor Truck Company, 100 London Street W. Approximate cost, $15,000.

Late News Items

Cornwall Township, Ont.
The Township Clerk, J. W. McLeod, Cornwall, will receive tenders until June 5th on a quantity of drainage work. Engineers, Magwood & Stidwell, Pitt St., Cornwall.

Edmonton, Alta.
The City Council have let the contract for construction of pavement on Namayo Avenue and First Street to the Crown Paving Company, 11351 82nd St. Approximate cost, $20,000.

London, Ont.
The City Council have let contracts for the construction of storm sewers to the following firms:—Webster Construction Company, Bank of Toronto Building, $9,961; J. H. McKnight & Company, 88 David Street, Toronto, $16,822; J. A. Laughlin & Company, Ottawa, $8,201; Arnot & Company, Foot of Berkeley St., Toronto, $41,898.

Montreal, Que.
In connection with the erection of an oratoire for the Corporation of Notre Dame College, Cote des Neiges, the contract for terra cotta, wall furring and partitions has been awarded to the Montreal Terra Cotta Company, Limited, Board of Trade Building. Approximate cost of building, $200,000.

The contract for supply and setting of marble in connection with the office building which has been erected on Dominion Square for the Sun Life Assurance Company has been divided between the following companies:—Mariott Marble Company, Provinciale Lane, the Missisquoi Marbles Ltd., New Birks Building, and the Smith Marble & Construction Company, Ltd., 145 Van Horne St.

Ottawa, Ont.
The general contract, masonry and carpentry required in the erection of apartments on Somerset Street for Harry Graham have been awarded to A. Christie & Son, Elgin Street, and the heating and plumbing to J. T. Blythe, Frank Street. Approximate cost, $25,000.

Port Maitland, Ont.
Tenders on the dredging of the channel of the Grand River will he received until 4 p.m., May 30th, by R. C. Desrochers, Secretary to Department of Public Works, Ottawa. Specifications at the Department.

Sherbrooke, Que.
In connection with the erection of St. Michael's Cathedral, the contract for terra cotta floor arching (Guastovino system), wall furring and partitions has been let to the Montreal Terra Cotta Company, Ltd., Board of Trade Building, Montreal. Approximate cost .of building, $175,000.

Toronto, Ont.
Tenders on the various trades required in the erection of a factory on Alice St. for the T. Eaton Company will be received until 5 p.m., June 1st. Plans and specifications at offices of the Architects, William Steele & Sons, Ryrie Building. Approximate cost, $500,000.

J. P. Lockhart, 197 Westminster Avenue, has commenced the erection of a residence at High Park Gardens, estimated to cost $10,000, and will let smaller trades. Brick and stone construction.

ESTABLISHED 1886

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Vol. 30 **May 31, 1916** **No. 22**

Principal Contents

Found—One Hour

On Sunday, May 21, Great Britain adopted the daylight saving scheme. It seems to us that there is everything to commend it and nothing to criticize. According to Premier Borden, daylight saving legislation in Canada is to be left to local option. A number of Canadian cities, however, have already adopted the system of getting up an hour earlier during the summer through the expedient of putting the clocks forward.

Like many other reforms the daylight saving scheme has been rather skeptically regarded. The success of the scheme will depend largely on the unanimity with which all the important interests in the Dominion support it. If one important interest adheres to the old schedule, the success of the scheme is impaired. It can be definitely stated, however, that its success in the municipalities that have tried it out shows conclusively how beneficial it is.

With everyone preaching war economy to his neighbor, this seems like a splendid opportunity to apply his form of thrift. Daylight saving means economy—reduction of light and fuel bills. Daylight is the natural time for work and recreation, even as the period of darkness is the proper time for rest. Observe the forces of nature—to sleep while the sun is shining is a reversion of nature's laws.

The chief benefits to be derived is from the standpoint of better health. A whole hour of daylight is gained for recreation, the nicest period of the day, that is, the hour at the present time between about five and six o'clock. One more hour for recreation, for social pastime, or for any of the small amenities of life; outdoor recreation and refreshment to banish the cares of the day and fit the body for sound and refreshing sleep, giving everyone renewed energy to go to his daily work and to do it more profitably both for himself and his employer.

Once changed, the objections of the chronic lay-a-bed to getting up an hour earlier are unconsciously overcome. Breakfast at 8 o'clock will still be at 8 o'clock. Things will go just the same as before; one's habits need not change except to take advantage of the extra hour. The factory whistles will still whistle at seven and six. It seems like a thrifty undertaking in times when thrift and economy are our motto. Leaving it to local municipalities to decide for themselves, however, is not going to give the most harmonious results. It will cause friction, for example, between one town having the system and another without it. It seems as if it would be better for the federal government to decide the matter for all. Great Britain, and many other continental countries have adopted a federal measure—why not Canada?

Town Planning a Modern Necessity

THE mad onrush of modern industrialism may be held largely responsible for the present condition of some of our larger towns and cities, with their utter lack of beauty and inconvenient transportation facilities. Municipalities are beginning to realize the state they have fallen into after a century of nothing but rush—and are stopping to consider. The subject of town planning has been very much in the public eye of late. It is a scheme which, it seems to us, might be appropriately considered at the present time. Involving as it does little expense in its consideration, it might provide a means for municipal activity that may be so advanced, now, that it could be immediately applied as a remedy for the demand for employment that will arise when the European war is over. The actual development of the scheme must wait, of course, for the return of normal times, but it could be so far advanced as to be ready for immediate execution when the time warrants.

W. R. Davidge, a district surveyor in the Old Country, who is remarkably conversant with town planning conditions in most of the Canadian and United States cities besides those of Great Britain, points out clearly the need of town planning, in a paper before the Surveyors' Institute, London, which is published elsewhere in this issue. Mr. Davidge confines himself to the general subject of town planning and the consideration of its broader principles. In Great Britain, with its congestion in the larger cities, the creed of town planning may be expressed as "more air, more accessibility, more attractiveness," or in other words, health and social well-being, especially as applied to prospective building land around the present towns and cities. Canadian and United States cities, on the other hand, regard town planning from one of two ideals, either the "civic centre" ideal or the "rapid transit" ideal, both of which smack like "good business proposals," and "business" is the keynote of American cities.

One thing stands out clearly, no matter what viewpoint is considered, and that is, the paramount need for some form of town planning at the present time, whether it be to clean up the slums within the present city limits or to plan for future development. Whether one wants merely a pretty city with lots of parks and public space, or one with good facilities for rapid transit, or both, the universal need for town planning is evident. Such a system cannot be called, as it were, a stock article, but must be made to order. A town's plan must be its own.

The question of tall office buildings and the overflowing of the business section into the residental district are items that must be considered in the town's plan. That an efficient system of rapid transit is one of the important items, is quite evident, yet this all-essential detail is often omitted in laying out a system. For many people, town planning begins and ends with the planning of roads. It is true, however, that the main roads into and out of a town are the skeleton on which the plan will hang together.

The subject of town planning in which provision for the future must be made, is not one man's job, but many. Every profession and every business should be heard and the plan should be the result of the cooperation between all interests, as interpreted by the engineer and the architect.

Letters to the Editor—Should Engineering Societies Pass on Public Questions

Calgary, Alta., May 19, 1916.

Editor Contract Record:

The Executive Committee of the Calgary Branch of the Canadian Society of Civil Engineers have authorized me to write to you, setting forth the facts concerning its action which was referred to in your issue of May 10, 1916, p. 445, under the title, "Should Engineering Societies Pass Upon Public Questions?"

Attached hereto is a statement of the facts. The question as to what action Engineering Societies can and should take in public matters in which the profession is interested has been much discussed lately. This is a record of how we handled such a case, and it is thought that it will be of sufficient interest to other engineering bodies to justify its publication, especially since a misleading reference has already been made to our action in your issue above referred to.

Yours truly,

Sam. G. Porter,

Secretary-Treasurer.

"Should Engineering Societies Pass Upon Public Questions?"

The author of the article under this heading in Volume 75, No. 17, Page 818, of the "Engineering News," undoubtedly refers to the action taken by the Calgary Branch of the Canadian Society of Civil Engineers in connection with the controversy over certain features of the construction of the large reinforced concrete arch bridge being built over the Bow River by this city.

The evident intent of the article is to create the impression that the society was not justified in taking the action which it did and that in so doing it was encroaching upon the rights of the consulting engineer.

The author passes over the facts of the case upon which the action of the society (of which he is a member) was based with one or two statements which are misleading.

As the precedent established by the society in the attitude which it assumed is new, a concise statement of facts will be given in order that the profession may judge for themselves of the merits of the action.

For a period of nearly a year previous to the matter being taken up by the society there had appeared in the public press a considerable adverse criticism of the engineering department of this city.

This came primarily from an alderman who had previously held the position of Waterworks Engineer for the city, but under a policy of economy his services had been dispensed with and the Waterworks Department placed under the City Engineer. He thereupon entered politics and was elected an alderman. He also opened an office for the practice of Consulting Engineering; hence his statements and opinions regarding engineering matters received far more consideration from the public than otherwise would have been the case. The work of the engineering department was greatly handicapped by this continual fault-finding.

Finally this criticism focused itself upon the construction of a large concrete arch bridge being built by the city over the Bow River at Centre Street, and charges were made to the City Council by this alderman which reflected upon the ability and good judgment of those connected with the city engineering department.

The City Engineer was an associate member of the American Society of Civil Engineers, and the local members of this organization realizing the serious nature of this criticism took the matter up with him, and after hearing his side it was the unanimous opinion of those present that any further discussion of these matters in the daily press could serve no useful purpose and that the local engineering profession would lose prestige if it was allowed to continue.

Furthermore, it was evident that if the facts were as he presented them, his reputation as an engineer was being attacked largely for political purposes. As this was a matter between engineers, it was felt that it should be settled within the profession and that the local branch of the Canadian Society of Civil Engineers was the proper body to which to appeal. This would be quite fair as neither party to the controversy was connected with this organization and its membership was thoroughly representative of the local profession, as well as containing some of the larger ratepayers of the city. At the same time the attention of the City Engineer was called to the fact that if the society could be prevailed upon to take the matter up that he must be prepared to abide by the findings of that body regardless of the consequences.

With this understanding the whole matter was laid before the executive board of the local organization.

In the meantime the City Council had ordered the two commissioners and mayor to investigate the matter and report. The alderman had been prevailed upon to submit the verbal charges in writing and the City Engineer requested to answer them in the same manner.

In the interim between the submission of the charges and the answers, the executive board of the society unanimously decided to offer its services gratis to the Board of Commissioners to investigate and report on the matter. A set of resolutions embodying this offer was then drawn and adopted at a general meeting of the society.

The city accepted the offer and requested the society to proceed.

Three members of the branch were then selected to act as a committee to make the investigation.

The meetings were public and held in the committee room of the council chamber at the City Hall, and the proceedings recorded by a stenographer furnished by the city. The alderman preferring the charges refused to appear befor this committee for examination and they had no power to compel attendance. On the other hand, the City Engineer, the engineer in charge of the design and construction of the bridge, and the city chemist, who had charge of the city testing laboratories, appeared and submitted very willingly to a thorough examination on the points at issue.

In brief, the charges were as follows:—

(a) The use of unsuitable re-rolled steel in the structure, and extravagance in the testing of same.

(b) Neglect or carelessness in not carrying the foundations of the north retaining wall to rock.

(c) Failure on the part of the engineering department to submit the design to a consulting engineer for endorsement, it having always been understood that such a course would be followed.

(d) The purchase of unsuitable cable for hoisting purposes during construction at a higher price than that at which suitable cable could be purchased.

The commissioners assumed the responsibility for (d), thus relieving the committee from its consideration.

A few extracts from the findings of the committee will indicate how much foundation there was for these charges:—

"As the impression conveyed by Ald. ———'s charges is that the safety of the whole bridge has been jeopardized by the use of this rerolled steel, the committee feel that this report is not complete without a statement as to what use was made or contemplated to be made of this steel. It has been used as reinforcement in the construction of the retaining wall which forms a part of the north abutment. It has also been used, or is contemplated, as dowels to furnish a bond between successive pourings of concrete in the river piers and springings. It was also used, or contemplated, in the curtain walls of the main piers and pylons of the river arches and as carrier or spacing rods in various other parts of the work. With the exception of the retaining walls where its employment has already been covered by this report, the function of the steel is arbitrary and the material is subject to no definite stresses. In the pylons, the curtain walls are a mere architectural effect and have no structural functions. The steel is used merely to prevent unsightly cracks due to temperature and shrinkage stresses and its section is in most cases far in excess of possible requirements.

The statement has also been made by Ald. ——— that because the Centre Street Bridge is larger than the Mission Bridge, a better grade of material should be used. This is not correct. Mere size is no criterion: in fact, the unit stresses in a large structure may be, and in this case actually are, less than in the smaller ones, and, if anything, a cheaper grade of material might be used with safety."

"Taking up the charges in order, as hereinbefore outlined, the committee submits its opinions:—

A. The question of unsuitable reinforcing material and extravagance in testing the same.

1. Cost of testing. The committee are of the opinion that the cost of testing will not be unreasonable, and that in all probability it will be less than a similar service performed by an inspection company.

2. Quality of steel. The committee are of the opinion that the use of rerolled steel in certain parts of the structure was warranted on the grounds of economy and that in view of the relatively high grade of the material the integrity of the structure has not suffered in any particular.

B. In the matter of foundations of the north abutment or retaining wall. The committee are of the opinion that the failure of this wall, from the causes outlined by Ald. ——— is a very remote possibility, and that the wall is safe against failure from the other possible causes outlined in this report. The committee are also of the opinion that the additional cost of carrying this foundation to rock would not be justified by any extra security so obtained.

C. In the matter of employing consulting opinion. The committee were unable to find that any suggestion to this end was ever made by Ald. ———, or any one else, and they also find that if the understanding existed, as stated by Ald. ———, it was not made public or communicated to the City Engineer.

The committee further are of the opinion that such a course was not justified on the grounds of cost.

After carefully reviewing the statements of Ald. ———, the City Engineer's reply thereto, the record of tests of material, and the plans of the structure, as well as the work itself, and the evidence submitted, the committee wish to state that they can find no reason for the charges and are unable to understand why they should ever have been made.

The committee understands that Ald. ——— could have had access to the plans of the structure at any time, as well as to the stress calculations. As his own statement shows, he had access to the correspondence on file in the engineer's office, and the committee understand that any further information which he might have required would have been cheerfully furnished on request.

From the evidence offered it would appear that the decision to use rerolled steel was submitted to the council and approved without comment from Ald. ———. In his statement to the mayor, Ald. ——— quotes portions only and these not continuous (although his statement would lead to that conclusion) from a letter to the rolling mills, signed by the City Engineer (Appendix 1). Had he quoted this letter in full, together with the reply, the inference would have been very different from what the portions quoted would seem to warrant."

The full report of the committee was filed with the city authorities and with the secretary of the parent society. The commissioners and the City Council adopted the report and thanked the society for their assistance. The council of the parent society also expressed its approval of the manner in which the Calgary branch had handled the matter.

The local society has no apology to make for the action taken. On the other hand, it believes that it has done a valuable service to the profession and the public in establishing this precedent and that if it was more generally understood that charges reflecting upon the ability of engineers in public office would have to pass the investigation of the local profession, that a great deal of unjust criticism would be avoided and the public relieved of a large amount of unnecessary worry.

Sam. G. Porter,
Secretary-Treasurer,
Calgary Branch, Canadian Society C. E.

Better Times

Building permits in Winnipeg, Man., to date this year, exceed by $500,000 those issued during the same period last year.

Elevators in Tall Office Buildings

General Rules for Their Arrangement — Design and Operation of Different Types Worthy of Careful Study

A subject of considerable importance, but of which apparently not very much is known outside of the architect's and designer's office, is the arrangement and knowledge of operation of elevators in tall buildings. With city specifications allowing for increased heights in office buildings, the question of how elevators operate and their most economical arrangement in the building to suit existing conditions, we believe should receive more consideration. The success or failure of a tall office building depends largely on the efficiency of its elevator service to accommodate the tenants during rush hours. No wideawake business man wants an office flat at the top storey of a high building with poor elevator accommodation, even if the building is situated in a desirable business district. It would be well if more people understood how an elevator operates; it might stand them in good stead at a critical time. Some of the problems of the arrangement of elevators in tall buildings and a few fundamental points on the principle of their operation are given here.

Number Required

Practical experience has evolved two theoretical methods for determining the number of elevators required for any building, which in practical use have given very satisfactory results. The two methods are:

1. Allow one elevator for every 20,000 to 30,000 sq. ft. of renting space above the first floor.

2. Allow 1 sq. ft. of elevator floor area to each 1,200 sq. ft. of renting space above the first floor.

The first method is perhaps the better one, as the number of cars is of more vital importance than the size of the cars; for it can be easily seen that two cars of 30 sq. ft. area each would give better service than one car with a floor area of 60 sq. ft. The greatest consideration in determining the number of elevators is to have enough cars, so that there will always be one at the ground floor ready to start on the upward trip. The greater the number of cars the smaller may be the ratio of the cars to the renting area, as with a large number of cars the problem of always having a car at the ground floor solves itself. Where there are less than six cars the ratio should not fall below the maximum of 30,000 sq. ft., while if there are ten cars or over the minimum of 20,000 sq. ft. may be safely used. The character of the tenancy of the building must be considered, for a building occupied by doctors, studios, or retail shops, all having many callers, will require more elevator service than a building occupied by big industrial companies having but few callers.

Location of Elevators

The general location of the elevators must be determined in relation to the typical floor plan rather than to the first floor plan, for here any extravagant use of floor space is multiplied by the number of floors. The elevators must be easy of access to all parts of the typical floors, a central location being the most desirable. However, in many cases a dark corner or the blank party wall is the wisest location, as these spaces are of little value for renting purposes. The bank of cars should be arranged so as not to divide the typical floor, because the renting area should be in an open space in order that it may be rented to a single tenant. This is easily accomplished when the elevators are on the blank party wall, but when they are centrally located greater care is required to prevent them from dividing the floor area into two parts which could not be used advantageously by a single tenant. In case both express and local services are employed the local cars should be stopped at an intermediate floor and space over them on the upper floors rented.

Freight Elevators

There are three methods for the arrangement of freight elevators in office buildings. The choice of a method depends upon the amount of freight that must be handled and the character and the promptness of the service required. These methods are:—

1. The most common and the most satisfactory method is that of having a freight receiving room and one or more freight elevators at the rear of the building, with direct access to the alley or receiving court at the first floor.

2. A more economical method, but a fairly satisfactory one, is that of installing a separate freight elevator at the rear of the building, but without a receiving room at any of the floors. In this case the elevator opens directly upon the alley as well as into the public corridor on the typical floors.

3. A third, and the more economical method, is that of using one elevator in common for passengers and for the delivery of freight, which means that no freight can be delivered during the rush hours, when the car must be used for passengers. Where this system is used it is usually necessary to install a lift to carry freight from the alley to the basement, where it can be sorted and stored until such an hour as it is possible to deliver it to the upper floors. This type of installation necessitates the delivery of small packages which cannot be delayed, as well as the carrying of the building employes in the passenger cars. Many tenants object to entering elevators with delivery men and building employes, so before this system is adopted the interests of the tenants and the character of the service to be given them, must be carefully considered.

Relation of Elevators to Lobby

As already mentioned, the location of the elevators will be largely determined by the arrangement of the typical floor, but their relation to the ground floor cannot be disregarded. The paramount requirement is that the elevators be in direct view of a person entering the building, and they should be as near the entrance as their disposition on the typical floor will allow. The directory board should be so located that visitors to the building will pass it on their way to the elevators, but so situated that those standing in front of it will not block the free passage of others. The mail box and the cigar stand must also be so placed that people loitering at either will not interfere with the free passage to and from the elevators. The entrance to the main stairs should be as near the building entrance as possible and always nearer than the elevators, as any callers to the second floor will walk up and they should not be forced to mingle with or block those passing to and from the elevators. If in any large building there are two entrances there should not be a bank of elevators at each entrance unless the building is large enough to warrant each bank having at least six cars.

Arrangement Within the Bank

The manner of arranging the elevators within the bank may be classed under four schemes, all of which may be varied as occasion demands.

1. The most common method is that of placing the cars in a line perpendicular to the street. Experience tends to show that this arrangement, when more than seven cars are required, is not entirely satisfactory, as with more than this number of cars the distance from one end of the bank to the other is so great that a person missing a car at one end is forced to walk too far to catch a car at the other end.

2. Another arrangement is that of placing the cars parallel with the street. For a small, shallow building this method is very satisfactory, but where a large number of cars are required it is subject to the same criticism as the previous scheme, although if the entrance corridor meets the elevator lobby opposite the centre of the bank this objection is overcome.

3. The fan-shaped bank of cars gives excellent results, but is extravagant of floor space. In perhaps no other scheme are the cars in so direct a view of a person entering the building or so equally distant from the entrance.

4. The U-shaped plan has from the point of service as great advantages as the fan plan, while it has much greater advantages from the point of economy of space and the possibilities which it offers for a good architectuarl treatment of the lobby. To the writer this seems to be the ideal arrangement for a bank of elevators. Upon entering the lobby a person can see every signal light and upon reaching the open side of the U he is almost equally distant from every car, so in case of missing the one for which he had started he has but a few steps to take to reach any other car.

Design of Grilles and Fronts

The design of elevator fronts is largely a matter of architectural design, but the various combinations of materials which may be employed in executing the design to some extent necessitates certain practical considerations as effecting the efficiency of the service. Generally speaking these treatments may be classed under three heads.

1. The first is that in which the entire wall surfaces are covered with marble, tile or terra cotta. When these materials are employed the danger to be avoided is that deep door reveals or heavy pilasters do not obscure the elevator doors, signal lights and indicators from the view of a person entering the lobby. In treatment of this sort the signal lights and indicators should always be outside of the door reveal. When the bank of elevators is parallel to the street this danger is not so great.

2. The next method is a combination of materials already mentioned, with more or less metal grille, in which case care must again be taken that neither pilasters nor columns project too much. The writer has known of several instances where it has been necessary, because of the projection of heavy pilasters, to reconstruct and to extend the signal light brackets after the lobby has been in use for some months. The same defect and the deepness of the door reveals were vital factors among those which necessitated the entire reconstruction of one lobby.

3. An all-grille front is the most desirable, as the contrast of the grille with other parts of the lobby aids in attracting attention to the elevators and a grille lends itself readily to a very flat treatment, thus obviating the dangers of protruding projections of the wall surfaces.

Experience has shown that the door widths should vary but little from 4 ft.; the doors should always be two-fold and, if possible, the two folds should slide in opposite directions, both of these items being of more than temporary moment in the speed and safety with which the doors can be operated.

The size of the cars will, of course, depend upon the conditions of each particular problem, but in few cases should a car have a floor area under 30 sq. ft. and seldom should it be over 50 sq. ft. The cars should always be wider than they are deep in order to avoid delay and danger of accident occasioned by passengers passing one another within the car.

Accessories

It is becoming quite a common practice to install wire glass behind elevator grilles. This does not detract from the appearance of a good grille and has two distinct advantages. The shutting off of the elevator shafts does away with disagreeable drafts which are so common in the corridors of large buildings with open elevator shafts, and the wire glass will often lower the insurance rate. The glass should be a clear wire plate, for and obscure glass is undesirable as the operator of the elevator should be able to see out from his car at all floors.

The signal lights and indicators should be placed immediately over each door and at a height not greater than 9 ft. The numerals and hands of the indicator should contrast in color with the dial, for as elegant as a polished bronze indicator may be, it is of little use, particularly when reflections of light strike its polished surfaces. The simpler the signal lights the better; nothing can be more satisfactory than a sperical globe of not less than 7 in. in diameter with different colored lights in the upper and lower halves, one for "down" and one for "up."

The call-back bell should be placed at the point where the elevator starter will be stationed, and the night bell should be conspicuously located at the end of the elevator bank which is nearest to the entrance of the lobby.

Floors in Cars and Before Doors

The problem of floors in the elevators as well as in front of the doors in the lobby at each floor is important for several reasons. A material selected for these floors must be very durable. It must be non-slipping and must present a surface which can be easily cleaned and which will look well when clean. To fulfill these requirements there seem to be but three materials which can be used satisfactorily: loose rubber mats, rubber tile, or cork tile. Loose rubber mats, although cheaper to install than either of the other materials, are neither so economical nor satisfactory in the long run. Rubber tile and cork tile wear well, are easily cleaned, and require no finished floor under them, while their non-slipping qualities are good.

Regardless of which one of these materials is used, a brass angle should be installed at the juncture between it and the marble or tile floor. The non-slipping surface should run the full length of the elevator fronts, and not just in front of the doors, as serious accidents have occurred to people slipping in making a short turn onto a marble or tile floor upon leaving the elevator.

Types of Elevators

There are two general types of elevators commonly used in tall buildings, namely, electric and hydraulic. The mechanism of a hydraulic elevator consists chiefly of a cylinder and piston with one or more rods connected to a cross-head, which carry the sheaves, over which run the lifting cables from which the car is suspended. Water, under pressure, is admitted by means of suitable valves, which cause the piston to move from one end of the cylinder to the other and back again. Motion is transmitted to the elevator car by means of the sheaves mounted on the cross-head, which carry a lifting cable. The cylinder may be either in a vertical position alongside the hatchway or in a horizontal position in the basement of the building.

In some cases the valves of a hydraulic elevator are operated by a hand rope passing through the car and over small sheaves at the top and bottom of the building and connected with the main valve in the basement. By pulling this rope down, the valve is opened and the car will ascend; by pulling the rope up the car is caused to descend. Two balls are attached to this hand rope, one near the top and one near the bottom, which serve as safety devices. The balls come in contact with the top or bottom of the car according as it is going up or down, and being carried along they move the cable, thus actuating the valve and bringing the car to a stop.

Another type of safety device often employed on this type of elevator is a set of safety clamps under the control of a speed limit centrifugal governor which causes the clamps to grip the guides and thus hold the car. This safety governor is operated by a small cable connected with the car and moving with it, which passes over the sheave pulley of the governor.

Other methods used for manipulating the water valves are by running ropes and standing ropes, either of which may be operated by means of a lever or wheel in the car. These devices operate a small pilot valve which, when opened, admits water under pressure to a small cylinder with a piston connected to the main valve stem. This actuates the main valve, which in turn, by its movement, closes the pilot valve. The opening of the pilot valve, and therefore the main valve, is directly proportional to the distance of the lever in the car from its central position. This central position is the position in which there is no flow of water either into or out of the cylinder. Moving the lever too quickly to a central position when the car is moving at a high rate of speed arrests it with a sudden jerk. The water pressure generally used for operating hydraulic elevators in ordinary buildings is from 150 to 200 lbs. per square inch. In high buildings where speed service is required, higher pressure is employed.

Another type of hydraulic elevator is the plunger type, one in which the car is placed directly on top of a plunger or piston. A cylinder is set vertically in the ground under the centre of the car, and the length of it is slightly greater than the travel of the car. In this cylinder is a plunger which carries the car. Water, under pressure, is forced into the cylinder, which lifts the car and is allowed to run out at the top when the car descends, so it is always full of water. The usual diameter of a plunger or such a type is 6½ to 7 inches, and it is constructed of lengths of polished pipe joined together with an internal sleeve and has its lower end closed. The top of the cylinder is arranged with a packing gland through which the plunger works up and down. Such a type cannot be overbalanced because the power acts only during the up stroke.

Overbalancing, or having a counterweight heavier than the car, is employed on electric elevators. It permits the use of smaller motors. Electric elevators are operated either by alternate current or direct current motors. Current is transmitted to the motor by an electro-magnetic controller, operated through a switch in the car. The brake on electric elevators may be either mechanical or electric. In an electro-magnetic control the brake is set by a spring or weight and is released by a solenoid. Limit stops, or lower limits of travel, are usually buttons or knobs placed on the shipper rope against which the car strikes and automatically shuts off the power. Such buttons are not sufficient protection in themselves. They are apt to slip or break. The more common form of limit stop is a gear wheel working loosely in an extension of the drum shaft. Should the car over-run its limit either on the up or down trip, jaws on the hub of the loose gear engage with jaws fastened to the drum shaft causing the loose wheel to rotate. This sets in operation the gear, which turns the shipper sheave, thereby reversing the motion of the elevator. Considerable power may be wasted in operating electric elevators by careless handling, that is, in making unnecessary stops and starts, as the power consumed by the starting torque of an electric motor is many times the power used in normal operation.

Cast Iron in High Speed Engines

In modern high-speed engines cast iron is the only metal which has proved satisfactory for the construction of such parts as pistons, piston rings, cylinders, and liners. The chief requirements are good running properties and resistance to wear. Up to the present time the mechanical properties have been regarded as of secondary importance on account of the thickness of metal used, but in the light of modern tendency towards the cutting down of weight it is possible that stronger irons will be in demand in the near future. Good running properties and resistance to wear are often confused by engineers. The two properties are undoubtedly connected with each other, but they are not identical, and cast irons are often condemned "because they do not wear well," when what is really meant is that they do not develop good working surfaces in use. It is impossible to correlate the wear with hardness. The internal structure has an important bearing on the resistance to wear. Cast iron consists of graphite plates set in a matrix of ferrite, pearlite, phosphide and cementite, in which ferrite predominates when the iron is soft and perlite is in excess when the iron is hard. Microscopic examination of worn liners shows that pitting has been caused by the removal of certain grains under the abrasive action of the rings assisted by the vibratory motion of the piston. This pitting has often been erroneously ascribed to the dislocation of the graphite plates. At the same time as this dislocating action is taking place, a kind of polishing in bas-relief is being brought about by the action of the dislocated powder suspended in the film of oil. Microscopic examination of worn surfaces often reveals the harder phosphide eutectic and the cementite grains standing in relief without the action of etching. Further, the continued rubbing action gradually converts the surface of the iron into the vitreous state, when the iron becomes what is commonly known as "glazed," and it is a well-known fact that this action may take place to such an extent that the surface becomes so hard that difficulty is experienced in filing it.

Grouting by the Pneumatic Process

An Economical Means of Stopping Leaks in Driving Tunnels and Sinking Shafts in Water-bearing Ground

IN tunnelling or sinking shafts grouting has demonstrated its effectiveness and has been the means of a great saving in the cost and maintenance of pumping machinery and in prospective profits. Contractors have lost thousands of dollars in tunnelling through bad ground when a knowledge of grouting methods might have been the means of causing them to adopt such a system and would have saved them considerably. There are attractive possibilities for grouting in tunnelling a heading which passes through water-bearing ground; but the field is not confined to tunnels and shafts, there are splendid opportunities for it on the solidification of dam sites. To obtain success with the process, however, a thorough understanding of and strict attention to all details are necessary. The process is doomed to failure if entrusted to men not familiar with such details. The following information on grouting in wet ground tunnelling, and the methods of filling cavities and cutting off water flows, is based on the experience of James F. Sanborn, division engineer of water supply, New York City, on the Catskill aqueduct, as given by him in a series of articles in the Engineering Record.

The purpose of grouting is to force a mixture of sand, cement and water, into the space to be filled. In view of the importance of securing a thorough job of grouting and the eliminating of leakage under pressure, careful consideration of the geology of the rock, the distribution, and the nature of the opening must be made, and the methods of grouting adjusted to meet such conditions.

Equipment

Considerations of the best method of drilling and placing holes for grouting, the proper consistency of the grout mixture, the best cement to use, what injection pressure should be applied and the best means of producing and controlling the flow of grout are among the matters most vital to the success of the process.

The best equipment to use in any case depends very much upon the pressure necessary to make the grout travel, and the consistency of the mix best adapted to the kind of openings to be filled. If a considerable yardage of grout is required, an equipment with large capacity is desirable, while a smaller quantity placed slowly under high pressure may demand a different equipment to secure the best results.

Grouting is often done by pouring through pipes arranged in such a way as to secure the necessary pressure. Commonly, however, more pressure than that afforded by the head of grout alone is required. The equipment ordinarily used may be classed as follows:

1. Reciprocating pumps furnishing a continuous flow with independent means of mixing the grout.

2. Grouting tanks, which are of two classes—(a) paddle mixing and air ejecting and (b) air mixing and air ejecting.

The paddle mixing and air ejecting type of grout tank has been extensively used on shield-driven tunnels and elsewhere. They have many advantages, and are economical when large quantities of grout are to be placed, as in grouting dry packing. The moving parts and stuffing boxes, however, wear rapidly, while the paddles and shaft become coated with grout. As the machines receive very little care in a tunnel, they wear out fast.

In grouting the shafts and pressure tunnels of the Catskill aqueduct the equipment consisted of tanks of the Canniff type, in which the grout was mixed, a batch at a time, and ejected by compressed air power through a heavy wire-wound high pressure hose, attached by fittings to pipes previously secured in position at the point where the grout was to be introduced; 2-in. or smaller grout pipes and 2½ or 3-in. hose was commonly used.

The compressed air is made on most contracts by air compressors of large capacity, which are part of the plant used while driving the tunnel and furnish air at pressures from 80 to 100 lbs. per square inch.

Canniff Grout Tank

The chief advantage of the Canniff grout tank is that it has no moving parts to be cut out by grit, leak air, and delay the work for repairs, as happens in the case of pumps. This advantage is greatly in favor of the grout tank, particularly for tunnel work, where the darkness and distance from the shop and supply room make renewals slow and expensive. The time lost in making renewals with this tank is very little, as only the gasket of the door and the valves are liable to wear. Its compactness and light weight are great advantages, as the floor space occupied by a tank is very small, not over 4 square feet. The Canniff tank is well adapted for handling grout rapidly. As high as 1,500 batches or 115 cubic yards of grout have been placed in one day of three shifts by a pair of tanks. A small force operates the tanks and no high-priced men are required for repairs or operation. Either rich or weak grout can be used, and the tank is adapted for low as well as for very high pressure.

A disadvantage of the Canniff tank is shown when used for high pressure work, when the grout is discharged very slowly into fine seams, taking a long time. In such cases the cement has time to settle out of the mixture and clog the openings. However, as very thin grout should be used in such cases, the difficulty is not very serious practically.

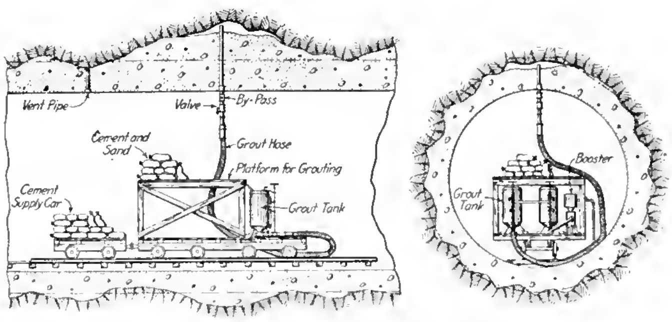
Care in Operation

Unless great care is taken with any type of grout tank to shut off the discharge valve, the instant the last of the grout leaves the tank, an after-blast of air follows, which has a bad effect in stirring up the grout. The air tends to collect in the space to be grouted and is displaced with difficulty by the cement. The men operating the tanks, however, become very expert in controlling the discharge. Both the air-mixing tank and the paddle-mixing tank discharging a single mixed batch by compressed air pressure, are well adapted to mixing and discharging a large quantity in a short time, especially into a large open space which takes grout easily. In work requiring high pressure, using thin neat grout, the results with the Canniff tank are very good. The grout commonly used is 1:1, but grout of a consistency of 1 cement to 2 sand is often mixed and discharged without trouble.

As in all grouting, for filling large cavities thick grout is placed, while for success in filling very fine seams, exceedingly attenuated mixtures are employed —5 lbs. of cement and 25 gals. of water in the early stages of injecting the grout—with the idea that the water will carry the cement as far as possible into the fine seams and avoid blocking up close to the drill hole. This is a very important point if complete success in the process of shaft sinking is to be attained.

Grouting Car

The grouting car and equipment generally used are shown in the figure. For the low pressure work two grout tanks are usually mounted on a car provided with a platform for handling the cement and sand, which is emptied directly from the bags into the grout machine (a bag of sand and a bag of cement to each batch), although two bags of sand are sometimes used to each bag of cement in grouting dry packing. The water is commonly added by hand by means of a bucket from barrels on the car or from the tunnel invert, although some contractors provide water tanks with an overflow at a designated height. These water tanks, of light gauge steel, are mounted on the grout tank and are emptied by a three-way valve. A belted centrifugal pump keeps a continuous stream of water circulating to supply the tanks, but does not always prove as reliable as a small air-driven reciprocating pump. The sand and cement are transported on flat cars by the tunnel mules or trolley motors to the grouting equipment and handled by hand. It is essential for the rapidity of low pressure grouting work that plenty of material be always stacked up on the grouting platform, as the operation is so rapid that the stock is quickly exhausted unless constantly renewed.



The General Layout of a Movable Grouting Plant in a Tunnel.

Plant for High Pressure Work

For the low pressure grouting, the air supplied by the compressors on the surface is usually found adequate, but for high pressure grouting air at 300 lbs. pressure per square inch is used on account of the high ground-water pressures, often over 100 lbs. per square inch being encountered.

The high pressure grouting equipment consists of a car, smaller than that used in the low pressure grouting and carrying one or two grouting tanks. The amount of grout used in the high pressure operation is only about one-tenth of that placed in the low pressure operation and, furthermore, it takes much longer to discharge each batch.

In addition to the grout tank, the high pressure grouting car often carries an air pump or booster operated by compressed air from the tunnel plant at 100 lbs. pressure, delivering air at 300 lbs. pressure to the grouting tank. Another grouting tank is commonly mounted on the car, but is used only as a receiver for the high pressure air. As in the low pressure operation, the grout is discharged through a wire-wound hose from the tank to the grout pipe set in the concrete or rock. Each pipe to be grouted is provided with a nipple and special plug cock to which the hose is attached by a union.

A wet tunnel is always slower and more expensive to drive than a dry one, as it is more difficult to keep the men working under a wet roof, and the necessity of pumping the water is an additional expense.

Filling Cavities

The space over the concrete arch in rock tunnels cannot be completely filled, as the soft concrete packed into the key settles away by gravity, leaving a void as much as 2 or 3 inches high above the concrete arch. Places where the rock breaks high are filled as completely as possible, and afterwards completed by injecting grout in the form of mortar. Experience has shown that this grout is very effective; no voids of considerable size are left. Where dry packing is used in bed ground which requires a support of permanent steel ribs and lagging, grout is injected to fill the spaces between the pieces of rock forming the rubble or cyclopean concrete.

Drains and drip pans placed between the rock and the concrete lining to waterproof the soft concrete against the incoming water from rock seams, is another illustration of that class of cavities of large size where thick mortar grout is used as a backing for the concrete. In this case the water is discharged through weep pipes through the freshly placed concrete to prevent the water, which is frequently under high pressure, from washing and disintegrating the lining before it has set. When it is necessary to shut off this water after the concrete has hardened, grout is injected to fill the drains and pans.

The grouting of large cavities requires the use of 2-inch pipes, through which the grout is injected. They must be carefully placed to lead the grout to the lower part of the cavities. Vent pipes leading from the summits of the cavities are placed during the period of concreting to permit the escape of air and water as the grout is injected. These vents further serve the purpose of telltales to show when the cavity is completely filled with grout.

For filling cavities of large size, sand and cement grout in a mixture of one part of each is used, mixed with a quantity of water just sufficient to produce a grout not too thick to be easily pumped.

Dry and Wet Cavities

Work of grouting large cavities divides itself under two heads. First, grouting dry cavities displacing water; and, second, grouting wet cavities displacing water. When both wet and dry cavities lie in close proximity and are connected, the best results are obtained by grouting the dry cavities first and permitting the grout to set before attempting to fill the wet cavities. If the wet cavities are grouted first, the water ordinarily shifts to some near-by dry cavity, thereby multiplying the number of wet cavities to be grouted.

Grouting Dry Cavities

When considerable stretches of tunnel are to be grouted, the usual method is first to grout the space over the arch and the dry packed stretches, using an air pressure of about 40 lbs. to the square inch, and, after this grout has set, to make a second trip through the tunnel to complete the grouting of any spaces over the grout first placed and also to grout all pipes and pans carrying water.

The first, or low pressure grouting, employs thick 1:1 sand grout, while the second, or high-pressure grouting, employs only neat cement grout injected generally under a pressure of 300 lbs. to the square inch. Entirely different methods are used in the two processes and a special plant is required in each case.

Rock Seams

The grouting of rock seams outside of a tunnel lining is, perhaps, the most difficult type of grouting. In the first place, it is hard to drill holes which will give adequate access of the grout to the rock seams. In the drilling operation, even though the hole encounters the crack in the rock which carries the water, the pounding action of the drill is liable to calk the cavity with powdered rock, so that when the grout pressure is applied it will not enter freely,

As a rule, there is a chance to inject grout into rock seams, and where the chances are poor, no definite rule can be given. The inward leakage is, in a sense, an index of the amount of grout that can be injected.

For injecting grout into rocks which show a seepage, but no considerable flow of water, three arrangements of grout piping are tried.

1. Drilling in enough deep-seated pipes to collect the water and protect the mortar from washing.

2. Putting in a drip pan with independent additional deep-seated pipes to the rock seams.

3. Using drip pans alone, grouting them with thin grout, then draining the pan and filling it with thick grout to complete the backing.

Experience seemed to indicate that the second method is a little the best, although in most cases the third method gives complete satisfaction in cutting off water.

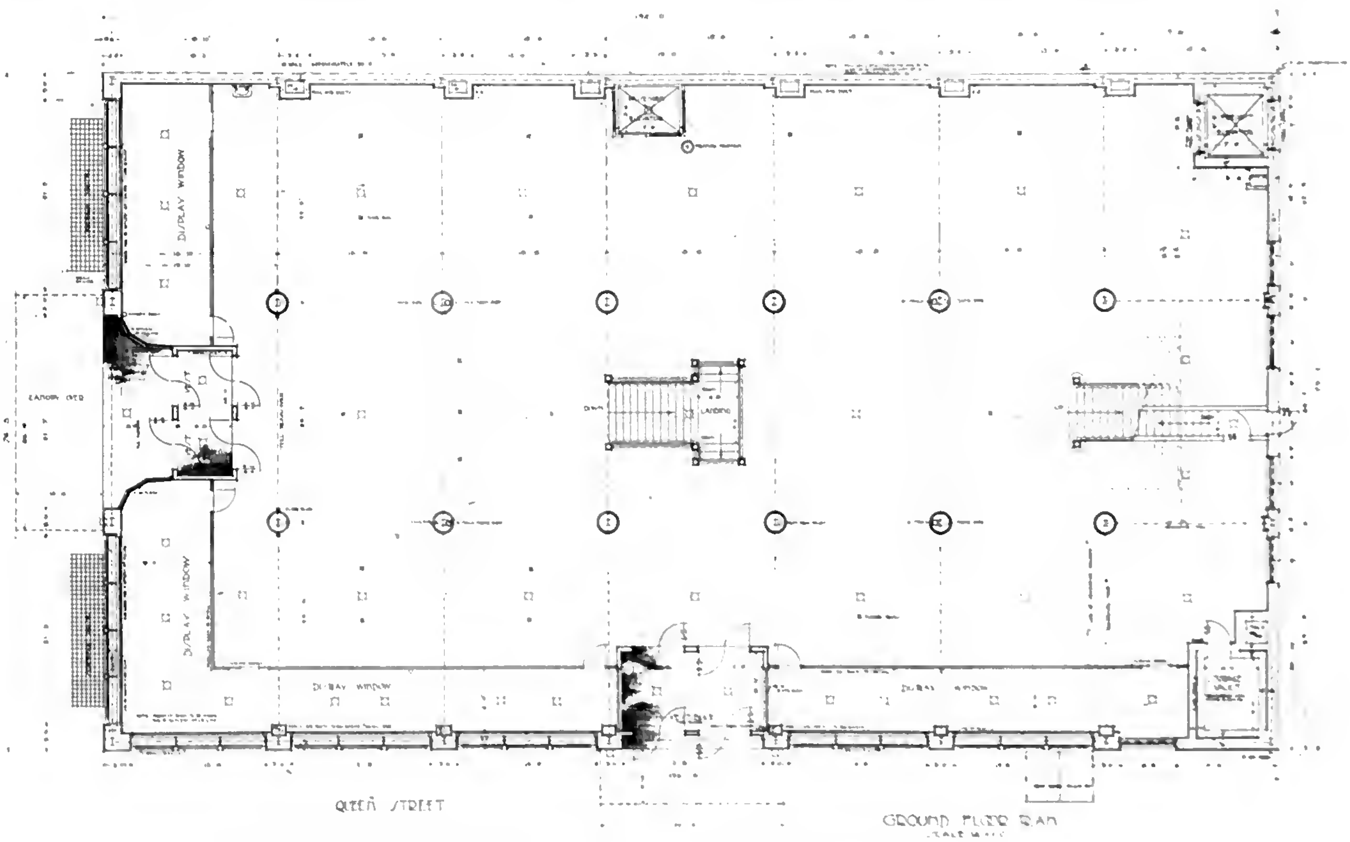
New Department Store at Brantford, Ont.

THE cut herewith shows the ground floor plan of a large department store recently erected in Brantford, Ont. It was built by W. C. Livingston on the corner of Queen and Colborne Streets and has been leased to the E. B. Crompton Company, Limited.

The store is of steel construction with reinforced concrete foundations and footings. The exterior walls are brick with artificial stone window sills and caps and cast iron cornices and copings. It is four storeys and a basement high and has main entrances on both Queen and Colborne Streets. The Colborne Street entrance has a wrought iron marquise canopy over the door. The entrance vestibule is approximately 15 feet square, while the Queen Street vestibule is 16 ft. x 9 ft., both vestibules are tile floored and have double plate glass doors.

The show window on Colborne Street is 9 ft. wide, and on Queen Street, 6 ft. wide. The window bays are finished in hardwood with wood and muranese glass back, fitted with sliding doors. The bays are lavishly lighted with large units.

The enquiry office is situated at the foot of the basement stairway in the centre of the store. There is also in the basement a parcel room, stock and shipping rooms, storage, cloak rooms, and the fuel and boiler rooms. The whole of the ground floor is taken up by store space. A 20 ft. mezzanine floor runs around the end of the building furthest from the Colborne



New Department Store, Corner Queen and Colborne Sts., Brantford. Angus and Angus, Architects.

Street entrance. The cash registers and general offices are located on this mezzanine floor. The first floor, with the exception of the rest room over the Colborne Street entrance, is given over to store space, while a grill room, dining room and kitchen are located on the second floor over the Colborne Street entrance. At the opposite end of the building on the same floor are public lavatories. The third floor is taken up entirely by store space. The building is equipped with both passenger and freight elevator service, besides having a flight of stairs at the centre of the building. The store is modernly equipped in regard to lighting, heating and ventilation. Angus & Angus, Sudbury, Ont., were the architects on the building.

New Great Northern Railway Station at Vancouver, B. C.

MESSRS. Grant, Smith & McDonnell, contractors for the new Great Northern Depot now being erected at Vancouver for the Great Northern Railroad Company, on April 14 awarded to Palmer Bros. & Henning, the contract of driving over 500 tall piles in the filled-in area of False Creek, lying east of Main Street, to support the foundations of the new structure. To-day work on the concrete piers is well advanced, and at the rate the mixture is being poured it will not be long before a start is made on the sub-structure. Mr. E. B. Ford, chief engineer for the Great Northern Company at Vancouver, has the details well in hand, being assisted by Mr. Fred L. Townley, the Vancouver architect, whose plans met with the approbation of the management at St. Paul, Minn. Trade tenders for most of the sub-contract work have been allotted, and the material is being assembled so that there may be no delay in connection with any department.

The new station will occupy a site on Park Lane 300 feet back from Main Street, and will be in line with the Canadian Northern Railway station, to be built in the near future. The depot will be a handsome structure of two storeys, with the terminal facilities on the main floor and offices above, the material selected being brick over reinforced construction, with granite base and terra cotta trimmings and cornice. The frontage will be 235 feet, with a depth of 54 feet. The baggage room wing, forming an "L," will extend back 210 feet, and will be one-storey in height.

The main waiting room, 34 feet high, will have two entrances from the street and two opening upon the train concourse, with a carriage entrance at the side. The room will have a terazzo and marble floor, marble base and ornamental plaster ceiling. Opening therefrom will be the men's and women's retiring rooms, toilets, immigrants' room, parcel and news, telegraph and ticket office, exhibition room, Customs office and depot master's office, baggage room, mail room and express rooms.

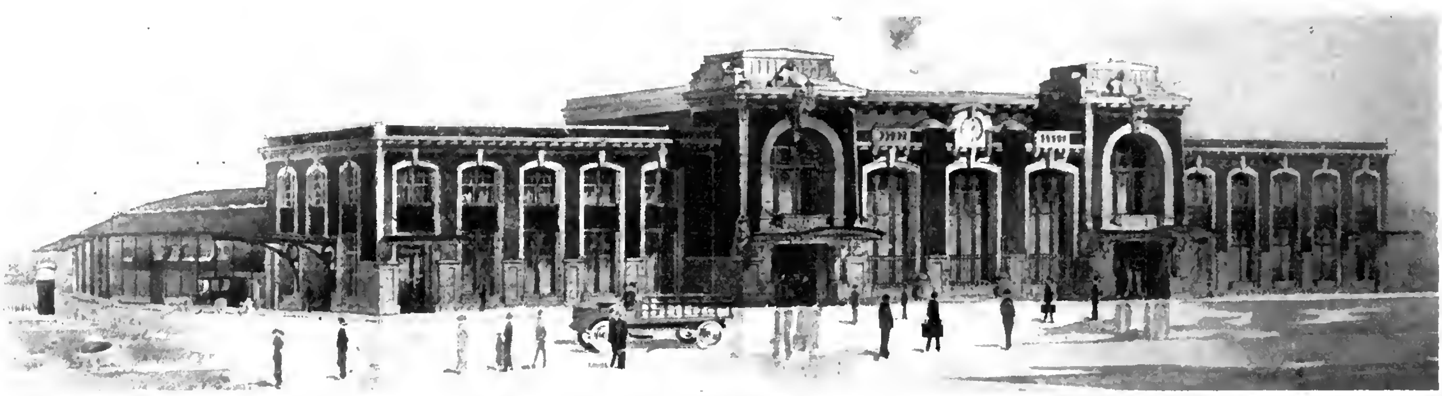
The passenger concourse will be glass-covered the full length of the building the width being 25 feet. There will be eleven sets of tracks, the train shed roofs extending a distance of 700 feet.

Heat will be supplied from an isolated power plant, pipes being brought into the main building through a tunnel. In all probability the electric light plant will be located in the same building.

Porcupine Good Roads Association

A Good Roads Association has been formed in the Porcupine district and already a policy has been outlined in regard to the treatment of traffic conditions in and around the gold camp. Acting through this association a number of prominent business men in the Porcupine district will approach the government in an effort to obtain assistance in improving the present highways and extending them.

The London Concrete Machinery Company, London, Ont., have secured contracts for the following equipment: City of London, one ¼ yard batch mixer for sidewalks; Guelph Department of Agriculture, one ¼ yard batch mixer and one cement drain tile machine; R. H. Barker & Co., Newmarket, Ont., one ¼ yard batch mixer; Schultz Brothers & Co., one ½ yard tower hoisting equipment; Westinghouse, Church, Kerr Co., of New York, one ¾ yard tower hoisting equipment to be used on construction work in Windsor; Shawinigan Water & Power Company, one No. 10 London elevated drum paving mixer; Morrison Brothers, Pense, Sask., one 1/6 yard batch mixer; city of Ottawa, one London elevated drum side discharging batch mixer with rotary delivery spout.



Handsome Building of The Great Northern Railway Under Construction on Reclaimed Area of False Creek Tide Flats, Vancouver, B. C.

The Benefits of Town Planning

The Need of a Carefully Thought Out Scheme to Provide Co-operative and Economic Conduct of all the Varied Interests.

By W. R. Davidge, F.S.I.*

BEFORE entering upon the discussion of accepted town-planning principles, it is well to realize that the term "town planning," embracing all communities large and small, is a very English one. In the United States and Canada the universal description of the same thing is "city planning," which seems at first even more inappropriate, until it is remembered that in America a community may be a "city" even if it has only 500 people in it.

With us the cities of London and Westeminster and our other cathedral cities are of so ancient a foundation that it gives us somewhat of a shock to find that many of our Colonial towns have springing up around them scores of such "cities." Melbourne, for instance, is surrounded with numerous growing suburbs, nearly a dozen of which are dignified by the name of "city." So general has the practice become that, by special enactment of the State Government, it is now possible to adopt the name of "city" as soon as the population reaches 20,000. The term "town planning," however, fairly correctly describes the methods so far adopted in England, as contrasted with the expression "town building" ("stadtebau" or "construction des villes") prevalent on the Continent. In this country, under the Act, our effort is principally directed to planning the land around our towns, and so far the architectural or "town building" side has hardly been touched. This variation in nomenclature expresses in another form the varying ideals and national characteristics of "town planning" or "city planning" as understood in the various countries of the world. It is well that this divergence of national outlook should be appreciated before we proceed to discuss "accepted principles, by whom accepted, where and why accepted." There has in the last six years been an amazing wealth of literature and such a mass of reports on various phases of the subject that it is somewhat difficult to disentangle the exact facts as existent. In Great Britain the creed of town planning may be expressed briefly as "more air," more accessibility, more attractiveness!" or in other words, health and social well-being, particularly as applied to the prospective building land around our towns. In conjunction with this there is at the same time, so far as private estates are concerned, a very evident effort, in some cases almost a straining, after the picturesque. In modern garden suburbs, equally with the mediaeval town, the effort after picturesque features has secured many charming examples, which are a welcome relief from the drab of the everyday town.

Municipal surveyors, as a body, fully appreciate the great possibilities of town planning from the health and amenity point of view, but so far, at any rate, the "picturesque" is entirely in the province of the private owner and his architect, aided or retarded by the jerry builder. In Paris the desideratum is more often the spectacular or monumental art of "construction des villes" in the grand manner. In Berlin "der Stadtebau" represents the same ideal of imposing public buildings and monumental-looking structures which are in reality tenement dwellings. As a well-known German professor said in 1910 at the Royal Institute of British Architects' Conference:—"What we in Berlin try to do is, at all times and to the utmost of our power, to impose upon the stranger!"

American cities mostly regard city planning fom one of two ideals, either the "civic centre" ideal or the "rapid transit" ideal, both of which our American cousins would describe as "good business propositions," and business is the keynote of all sound proposals.

Colonial towns are, as is well known, mostly laid out (for the convenience of the surveyors) on north and south lines, with all streets at right angles, and, until quite recently, this tendency has manifested itself in the lay-out of practically all towns which have had to be developed rapidly, generally in the absence of any special natural features.

It has been necessary in nearly all cases to peg-out and sell plots of land rapidly, and the Colonial surveyor in laying out a town has almost unconsciously come to regard it as "cutting up so many sections," simply and solely "land jobbing." The idea of a community deliberately moulding its own growth to its future needs has so far hardly been realized.

The Need for Town Planning

One thing that stands out clearly, though, in the maze of these different national and local characteristics is the paramount need for some form of town planning.

Whether one sets out with the purpose of sweeping away slums or of providing for the future growth; whether one is an enthusiast for parks and open spaces, or merely desirous of the commercial advantages of rapid transit and business facilities, all nations and nearly all communities are agreed that, if it is reasonable to plan the alterations to a house that one intends to inhabit, it is still more desirable to plan the town and its extension; hence the first general principle which we can all accept is the universally recognized need for town planning.

Our first accepted principle, then, is:—A town plan is necessary.

Following on this, however, must come the recognition that such a town plan is not a stock article, but must be made to the measure of the district. National characteristics and aspirations, as we have already seen, have resulted in widely varying national conceptions on the subject of town planning, and localities vary as widely in their views as to development, particularly as to the kind of development which is suitable for their town. A town's plan must be its own.

From the point of view of protection of property-owners in residential districts, some form of restraint as to the location of commercial buildings is clearly necessary, and, so far as the Act has gone, the constitution of separate areas for factory and commercial purposes has been carried out without difficulty.

As so many of us are aware, however, the real test of such restrictions will be felt in the next generation. With the continual growth and prosperity of a town the commercial area will surely expand, and unless

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adjacent space is provided for expansion the business side of the town will necessarily overflow into the residential quarters. In all old centres this alteration of use is continually before our eyes. In New York, within the last few years, business which formerly was done in Twenty-third Street has now moved up as far as Forty-second Street, and an entirely new shopping district created.

Even in London the one-time quiet residential Hanover-square is rapidly assuming a commercial character, and the once peaceful quiet of Soho Square has long been broken into by the pickle factory. Such changes are in the nature of things, and, however hard and fast the restrictions of a town-planning scheme may be drawn, it is evident that unless the plan itself also provides for extension mere legal restrictions will have no more force than the out-of-date paper restrictions of many one-time high-class residential estates, more honored in the breach than in the observance.

Provision must therefore be made for the gradual expansion of commercial districts.

The phenomenon of the overflowing of business into the residential areas of a town is constantly before our eyes, but it is curious to note that in nearly all towns, no matter how old, the heart of the business community still has its nucleus in the area of the original settlement.

Increased Height of Business Premises

It is the endeavor to crowd as many office buildings as possible near this commercial centre that has created the "skyscrapers" of Lower New York. This tendency towards increased height of buildings in commercial centres is equally noticeable in such cities as Sydney, Melbourne, Winnipeg, Vancouver, and even in comparatively small cities like Regina. There is everywhere a tendency to increased height of business premises.

Control of Building Heights

The New York authorities have given much consideration to the important question of regulating the height of buildings. In Lower Manhattan there has for many years been a growing tendency towards the erection of tall "skyscrapers," mostly office buildings. The excuse for this has been the limited area available in the older commercial quarter of the city, but the real purpose has in many cases probably been for advertisement purposes. The Woolworth Building at present easily holds the record.

Limits of Height

The limits of height of buildings in various cities are at present as under:—

London.—80 feet.

Paris.—In streets less than 40 ft. wide, street width plus 20 ft. In streets over 40 ft. wide, 58.64 ft. plus ¼ (width—40 ft.).

Berlin.—Maximum 72.2 ft. (22 metres).

Boston.—District A. 125 ft., or 2½ times width of street. District B, 100 ft., or 1¼ times width of street. (Buildings over 80 ft. only allowed on streets over 64 ft. wide.) Special restriction to 70 ft. on blocks adjoining State House.

Washington. — Pennsylvania Avenue. — 160 ft.; other business streets, 130 ft., or street width plus 20 ft.; residence streets, 85 ft.; or streets over 70 ft. wide, street width minus 10 ft.; streets 60 ft. to 70 ft., 60 ft.; streets less than 60 ft., street width.

Other American Cities.—Baltimore, 175 ft.; Chicago, 200 ft.; Los Angeles, 150 ft.; Salt Lake City, 125 ft.; Toronto, 130 ft.

New York.—Limit of height of apartment and tenement houses, 1½ times street width.

The New York Commission recommend the limit of height for all buildings within 100 ft. of Fifth Avenue to be 125 ft., and that the general restriction for residential districts should be 1½ times street width, i.e., for 60-ft. streets height would be 90 ft., and for business streets twice street width with maximum of 300 ft. A number of American cities, including Baltimore, Milwaukee, Minneapolis, and Los Angeles, have in recent years established separate residential and industrial districts.

Trade Facilities

The provision of efficient and up-to-date means of transit is one of the most important items in the development of towns; yet, strange as it may appear, this all essential detail is omitted from the calculations of many would-be town-planners.

In America, where distances are so immense, the transit question inevitably bulks largely, but especially in recent years American towns have given more and more attention to the problem of the quick distribution of passengers from the outlying districts to and from the central or business portions of a town.

"Rapid transit" is therefore one of the first considerations of our American cousins in considering the problem of town development, and it is indeed strange that we in this country are only dimly beginning to realize this in our struggles after new and improved arterial roads. Main roads and motor traffic are, however, only one part of the problem, and in America many experts are giving their attention to the solution of the transit problem as a whole.

It is naturally found that property in the neighborhood of a "rapid transit line" develops more rapidly than other parts of the town, and if only one such line exists it will naturally absorb the greater part of the normal growth of the town.

The question of the amount of traffic to justify the construction of a tube railway or tramway subway will depend upon local geographical and commercial conditions, but it is a curious fact that, so far as this country is concerned, no town with a population of less than half a million has ventured to introduce a tube railway or electric "rapid transit" line.

Arterial Roads

For many people town planning begins and ends with the planning of roads, and there can be no gainsaying that the main roads into and out of a town are the skeleton on which the plan will hang together. They may, in some instances, be the "bone of contention," but all will be in agreement with the general principle of fixing the routes needed for new main roads, including, of course, reasonable circumferential and cross-roads. The routes for arterial roads should be laid down at an early stage in the town plan, and definitely secured or sterilized from other uses.

Roads and Road Widths

Much discussion and many conferences during the past six years have taken place on the question of road widths and construction, especially perhaps as to the allocation of space for various classes of traffic.

The general principles arrived at may, I think, be reasonably summarized as follows:—

To secure easy and rapid transit—

(1) Classification of roads is desirable.

(2) Provision for fast and slow traffic (fast traffic

should not have to slow up for cross-traffic), and separate tracks for tramways.

(3) Sufficient width of roadway for the traffic, but not too wide to be maintained.

(4) Sufficient width between buildings for all future purposes.

To secure the amenity of the highway—

(1) Good views from the road—preserving view points.

(2) Good views of the road—trees, but not too thickly planted.

(3) Pleasant walks alongside the road—grass and trees where possible.

(4) Pleasant halts by the way—an occasional village green or open space.

It should be borne in mind that estate development is not necessarily an object of main roads.

And in the lay-out of estates the principles laid down in my paper at this Institution six years ago still hold good, viz.:—

(1) Main routes must take the direction required by the traffic and contour of the ground.

(2) Geometrical planning is not necessarily satisfactory.

(3) Long straight streets, when adopted, should have a definite motive.

(4) Slight curves or irregularities in frontage lines and building lines may often be adopted with advantage.

(5) Line of sight should in most cases be restricted within reasonable limits.

Relaxation of By-laws

A very important point on which most people are now agreed is, that, while it is desirable to have a minimum distance between the building lines, a hard-and-fast by-law width is undesirable whether it be 40 ft. or 50 ft. (or 66 ft. as in the Colonies).

The power to fix building lines is important.

The width of macadam or roadway paving provided should be dictated by the use to which the street is put.

In residential streets the remaining width available may reasonably be devoted to grass margins and tree planting.

Compulsory Town Planning

Another point which has been much discussed is as to the desirability or possibility of making town planning compulsory, and it is probable that all will be agreed that the time has not yet come for compulsory town planning.

In Massachusetts and other States the appointment of a town-planning board is compulsory for all towns with a population of over 10,000. In Canada the Nova Scotia Town Planning Act, passed in April, 1915, makes town planning compulsory for the whole of Nova Scotia, and this experiment will be watched with interest.

Progress in the Colonies and India

The other Canadian provinces which have adopted special town planning Acts are New Brunswick and Alberta in 1912. It is probable that the remaining provinces will shortly follow suit, and the same may be said of the various Australian States and the New Zealand Government. In India the Bombay Government has already led the way in this respect.

American Ideals

American city planning may be divided into four phases:—

(1) Rapid transit (already touched upon), which may be described as the engineer's ideal.

(2) The civic centre, which may be described as the architect's ideal.

(3) The provision of diagonal avenues and parkways.

(4) The provision and linking up of parks, and the scientific distribution of children's playgrounds.

The Civic Centre

The value of magnificent monumental buildings, in encouraging a sense of civic pride, is everywhere appreciated, and this, no doubt, is the reason for the American thirst for civic centres. The idea of an architectural conception or ideal, however, is unfortunately in most cases limited to monumental enterprises of this type which are little likely to be carried into effect, and the cost of which would be almost prohibitive. It is strange that such an eminently practical people as the American should devote so large a portion of their "city planning" programme to the provision of these costly civic centres, while allowing miles on miles of rectangular blocks and hundreds of five-storey tenements to be built in all directions without a murmur. Business centres and subsidiary centres will nevertheless form themselves in every town.

Diagonal Avenues and Parkways

It is a remarkable commentary on the rectangular block system of development everywhereto be found in the United States that, almost without exception, planning commissions are reporting in favor of the construction of new diagonal avenues across the rectangular system to provide access in a radial direction to and from the centre or business portion of the various cities.

The rectangular system of lay-out has generally proved quite satisfactory so long as the town remains of limited size, but once the town develops beyond the original square mile or so some form of diagonal communication becomes a necessity, and the improvement plans that are being prepared by practically all American cities are realizing this essential point. Philadelphia has already spent some millions on the Fairmount Parkway," which is nothing more or less than a diagonal of this description. The improvement plans of Brooklyn and scores of other cities in the States, and even so far afield as Santiago in Chili, all show the now generally appreciated need for diagonal routes.

The Linking-up of Parks

The linking-up of parks by a system of parkways or tree-lined avenues is also a well-recognized part of American city planning.

The South Park system of Chicago is an excellent example of what can be done in this direction; but Minneapolis, Kansas City, and many others, are all examples of the same tendency. In fact, there is a danger that the new fashion of city will be almost as stereotyped as the old.

Provision of New Parks

The need for parks in the outskirts to provide for the growth which must come is everywhere realized, and during the last few years there has grown up a system of acquiring such parks for the public by means of a special rate or levy made by the Park Commissioners on all land in the neighborhood, the value of which will be improved by the presence of the park.

In this way many large areas have already been secured at Kansas City, Minneapolis, and elsewhere at little or no direct cost to the ratepayers, and it has been found in practice that the betterment in value of the property in the neighborhood of the park more than recoups the owners for the small special rate they are asked to pay.

We may well ask ourselves whether we should not now be securing further and larger breathing spaces around the built-up area of all our large towns, and we might perhaps at the same time take a leaf out of modern American practice in order to relieve the ratepayers from any unnecessary burden.

The Preservation of River Banks and View-points

In America it is now a well-recognized practice that river banks and valleys should as far as possible be preserved for park purposes, and that view-points and hill-tops should be similarly preserved.

Such a course is desirable not only from the point of view of amenity, but to secure the stream from contamination, and, at the same time, utilize land which in ordinary circumstances would be unsuitable for building purposes.

Street Planting

Not only is it necessary to preserve the hill-tops and valleys and other natural beauties, but as far as possible the amenities of town life. In most communities there is a considerable proportion of the population which enjoys reducing everything to a dull level of ugliness, and seems almost to take a delight in removing everything in the nature of a tree or shrub.

The maintenance of trees and grass is always a troublesome question in England, especially in the neighborhood of our manufacturing centres; but in America, although they have equally busy manufacturing districts, it seems quite easy to dispense with forecourt fences and to throw open stretches of greensward right up to the house itself. Such a town as Rochester, N. Y., or Detroit, Mich., for instance, where thousands of motor cars are manufactured every year, despite the absence of fences there is abundance of grass and trees, and nothing can surpass such towns as Los Angeles and other towns of the West and Middle West in this respect.

The way in which trees are ruthlessly cut down in this country whenever an estate is developed still leaves room for education, and the same process of destruction takes place wherever our countrymen settle. It would be a good thing if a license had to be obtained from the local authority before cutting down any tree of over twenty years' growth, but this is a reform which has yet to come.

Control of Advertising Hoardings, etc.

The control of street advertisements and hoardings comes within the powers given under the Town Planning Act, and here, too, public opinion is coming round to the view that advertisements need not necessarily be ugly.

They very often are, it is true; but this is more often due to want of thought than deliberate intention to offend. Too often the landscape along our railway routes and main roads is stamped for ever in our memories with "Pott's Pink Pills" or "Biles' Bilious Beans," writ large in the foreground. Such monstrosities ought for ever to consign these goods to perdition, but short of this all such advertisements should be subject to annual license by the local authority and a good license fee per square foot.

The establishment of tentative experiments in civic survey work for particular areas has revealed to some extent the mass of preliminary information and statistical data necessary to a full understanding of the problem. In few, if any, cases is it possible for a man to grasp the details of the many-sided issues which beset the problem of town planning, and the civic survey is an attempt to bring together and collate the whole of the available information in a graphic form which will appeal not only to the professional town-planner, but to the members of municipal councils and others who often have not the time to properly study the problems affecting their town.

The heads under which such information is most profitably grouped may be taken as:—

(1) The site: (a) topography; (b) history.

(2) The industries: (c) growth of commerce; (d) causes and direction of growth.

(3) The transit: (e) traffic requirements—origin and directions; (f) water traffic, railway traffic, road traffic.

(4) The enjoyment of life: (g) health requirements, water, sanitation, fire prevention; (h) amenities, architecture, parks, and playgrounds.

And last, but not least:—

(5) Financial considerations: (i) land value and property; (j) rating, taxation, and loans.

It may seem to some that this covers almost as wide a field as the examinations of the Surveyors' Institution. If so, it is a tribute to the skill and forethought of those who have planned the Institution's examinations to embrace the many-sided activities of our many-sided profession.

Conclusion

In matters of town planning, however, we must realize that to foresee and provide for the whole future growth of our towns is not one man's job, but many.

Every profession and every business has a right to be heard, and the plan itself must be the result of whole-hearted co-operation between the surveyor, the engineer, and the architect.

In the town plan an attractive site is of little good without proper means of communication and efficient buildings.

The most perfect of communications by rail, by road, or by water will be unsatisfactory unless the site is wisely chosen, properly surveyed, properly drained, and properly built.

The most attractive design or grouping of buildings will be of no avail unless the site is first of all suitable, the roads are properly graded, and the means of communication the very best that can be obtained.

Co-operation, therefore, between the professions is necessary from the earliest stages of a town-planning scheme, and so far as this Institution is concerned we can rely upon its willingness to do its share in co-operation with the architect and the engineer in the important work of planning the future of our towns."

Smoke Consumers in Sherbrooke

The Sherbrooke, Que., city council has passed a by-law making it compulsory for all manufacturing plants using soft coal to install smoke consumers. As there are some twenty such plants in the city which must comply with this by-law, manufacturers of smoke consumers will do well to cover this field.

The Manufacture of Portland Cement

What Portland Cement is, and a Description of the Different Processes Followed in its Production

THE field of Portland cement has become so broad, with its applications to foundations, fortifications, bridges, breakwaters, docks, canals, reservoirs, dams, buildings, sewers, silos, streets, in fact almost every other field of constructional endeavor, and works of remarkable neatness and durability have been executed, yet there are a great many builders and contractors who, when asked how Portland cement is made, show a hesitancy that denotes ignorance. Mr. A. C. Davis, F.C.S., Assoc. Inst., in a paper before the Institute of Civil Engineers, Ireland, gives a good description of the manufacture of Portland cement. The following is abstracted from his paper:—

What Portland Cement Is

Portland cement is a chemical product obtained by the preliminary mechanical combination of carbonate of lime with silica and alumina, and which after passing through the succeeding stages of manufacture becomes a mixture of silicates and aluminates of lime.

Portland cement can be produced from any raw materials containing constituents capable of yielding, by calcination of silicates and aluminates of lime which form its chief components and the necessary constituents of these raw materials are lime, silica, and alumina. Small additions of iron oxide are desirable for fluxing these materials.

The raw materials, therefore, used for the manufacture are carbonate of lime, usually in the form of chalk or limestone, and silica and alumina, usually in the combined form of shale or clay. The two materials for the necessary combination indispensable for the manufacture of cement are not always found upon the same site.

The suitability of locality depends upon the manner of the occurrence of these requisites, the location of the deposit with respect to the cement-consuming market and the fuel supplies, for since with every ton of cement manufactured there will be used half-a-ton of coal, the location of the factory in regard to cheap fuel supplies is quite an important factor.

If it were at all possible to find a geological formation of uniform composition containing exactly the right amount of naturally mixed chalk and clay, Portland cement could be made from it by the cheap and simple method of merely burning lumps of the material as quarried, and grinding the resultant materials, but since such a material has not been discovered, this method of manufacture is hardly practicable, for a variation of even one per cent. of the proportion of carbonate of lime in the raw materials, to say nothing of the irregular composition of the other ingredients, is sufficient to destroy the reliable quality of the resultant cement.

In manufacturing Portland cement, however, carbonate of lime and clay, or other argiliaceous material, are first efficiently and accurately amalgamated in certain fixed proportions, either with the addition of water to the raw materials, or by the fine grinding and mixing of the same in their dry state.

The composition of a prepared mixture of these raw materials should be roughly three parts of chalk or calcareous constituent to one of clay or argillaceous constituent.

In the United States most of the cement produced is from the Lehigh Valley argillaceous limestone which contains rather more clay than is required for a correct mixture. To this a small amount of pure limestone, usually 10 to 20 per cent., is added, to bring the mixture up to the necessary percentage of calcium carbonate required in the manufacture.

It will thus be seen that, given chalk and clay in approximate proportions of 3 to 1, or lime with silica and alumina in any other form, it is of the first importance that these materials shall be treated with a full knowledge of the all-important chemical and mechanical operations of combining them, which alone can secure the manufacture of a reliable product.

The preliminary mechanical blending of the raw materials for the manufacture of Portland cement is a stage requiring the utmost technical skill, for the thoroughness of the process primarily determines the quality of the resulting cement, and if the manufacturer is to turn out a product of reliable quality, the scientific supervision of this branch of the manufacture is of paramount importance.

The first conditions of any method of preparing raw materials for Portland cement manufacture are, that they shall be (1) correctly proportioned, (2) very finely comminuted, and (3) thoroughly mixed.

The proportions of chalk and clay must be kept to a standard as close as possible to the ascertained analysis, work which, at the present time, in the most successful cement works, is carried out under the supervision of the works chemists.

It is firstly essential that extreme care should be exercised in obtaining the correct proportions of the chalk and clay, or whatever other raw materials may be used in the process, so that the resultant mixture may be relied upon to contain the exact chemical constituents necessary for the manufacture of a thoroughly sound cement; for, if the raw materials are not mixed in this proper proportion, nothing can be done later to correct it, and the result will be an inferior product.

The proportion of the ingredients is governed by continuous laboratory checking of the raw materials as they are quarried, and this testing by the works chemists goes on night and day or as long as the manufacture is proceeding.

Processes of Mixing

There are two principal methods of mixing the raw materials: namely, firstly, by the "Wet Process," applicable mainly, though not solely, to soft materials, the correct quantities of the raw ingredients being ground and mixed by the aid of a considerable amount of water. Secondly, the "Dry Process," in which the perfectly dry materials are ground together to an impalpable powder or "flour," and subsequently mixed to correct chemical proportions.

The wet process of mixing the raw materials is particularly adapted to such materials as are easily disintegrated by the addition of water. By this process the chalk, as quarried, and clay, are weighed into what is called a "washmill," where a large amount of water is added. The wash-mill is a circular brick-lined pit, some 15 feet or more in diameter, and 5 feet deep. In the centre of this pit is a concrete or brick pier carrying a vertical shaft driven through a crown-wheel and pinion. The vertical shaft carries a circular framework, from which are suspended harrows fitted with steel tines. The passage of these tines through the chalk and clay suspended in water tends to break up the lumps and convert the mixture into a liquid of thick creamy consistency, which is kept in the mill until it is fine enough to pass the screens covering the outlet ports. The product of the wash-mill is termed slurry or slip.

In some instances the further reduction of the raw materials is effected in wash-mills alone, while with some harder materials it is necessary for the slurry to be treated finally in the tube-mill.

Slurry from a wash-mill plant contains about 42 per cent. of water, and leaves a residue of less than five per cent. of its solid constituents on a seive of 32,400 meshes per square inch.

The tube-mill, as used for wet grinding, consists of a drum (about 20 feet long and 6 feet diameter) made of steel, and protected against wear and tear by renewable cast-iron plates. The drum is nearly half full of flint stones, and its interior is easy of access through manholes. The raw mixture, previously reduced by the wash-mill, flows through a hollow journal into the grinding drum, which slowly revolves. After being thoroughly ground by the flint stones, the material is discharged through the hollow journal at the opposite end.

In the latest practice the wet process is somewhat modified to allow of harder materials than chalk and clay being treated thereby. This modification is known as the "Thick Slurry" process, and the raw materials are first of all crushed to a size not exceeding a 2-inch cube, then passed into a mill of the ball-mill type—i.e., a revolving drum containing steel balls up to 5 inches in diameter, together with a stream of water. The partially ground slurry issuing from the ball mill is then treated by a tube-mill, where the final reduction occurs.

"Thick slurry" contains about 35 per cent. of water and is usually even more finely ground than wash-mill slurry.

Dry Process

In the dry process method of dealing with the raw materials for cement manufacture, the calcareous and argillaceous materials, of whatever substances they may be composed, have first to be dried after passing the preliminary crushing machinery. The dryers often take the shape of expensively constructed brick-work kilns, but, with the more general adoption of the dry process of manufacture, little time was lost in inventing a less costly and more efficient plant which could also be worked at a much reduced labor cost. The dryers now usually employed, therefore, in the most modern plants, consist of revolving cylinders some 30 or 50 feet in length, and about 4 feet in diameter. These rotary drying drums, as they are termed are supported on steel tyres, resting on heavy friction rolls, and the drums are rotated when in use at a speed approximating two revolutions per minute, and are usually set with an inclination of about one-half inch per foot.

The raw materials after passing the crushing rolls are introduced into the upper end of the dryers, and are immediately caught by cascading channels fitted inside the drums, which lift and drop the crushed raw materials as the drum revolves, and present them to the hot gases passing through the drums in the opposite direction to the way the materials are traveling to the lower or outlet end. The waste heat from the kilns is thus employed for drying purposes; or, again, furnaces are sometimes arranged to rotary dryers for the external heating of the drum.

Dry Grinding and Mixing

The raw materials after being crushed and dried must then be reduced to an extremely fine powder or "flour" by such plant as is adapted for clinker grinding, and then are carefully and thoroughly mixed to the proper chemical proportions before being conveyed to the kilns for burning.

This dry process of manufacture has been employed where the raw materials cannot be satisfactorily reduced by wash-mill plant.

In United States and Canada the dry process is generally adopted.

Preparing Raw Materials

It will be seen, therefore, that in preparing the raw materials for the manufacture of cement, the chalk and clay, or other materials of similar composition must first be reduced to the utmost fineness, either by the addition of water or by dry grinding, either of which processes breaks down the cohesion between the particles, and leaves the material in a very finely divided state, the physical properties of the respective materials to be dealt with generally determining which method of reduction is to be adopted.

Final Composition of Raw Materials

Now, before the prepared raw materials pass to the next stage in the manufacture—that of burning—the composition of the raw material mixture is ascertained by analysis and tests and the carbonate of lime (familiarly known by its chemical formula, $CaCO_3$) should be kept within, at most, one-half per cent. of the quantity found to produce the best cement. This percentage of lime varies slightly in different works, according to the many geological formations contributing to the manufacture, but, roughly, a combination of 75 per cent. of chalk and 25 per cent. of clay will produce a cement of good quality. If any carelessness is permitted in the mixing process, the results are likely to be disappointing, for when the proportion of clay runs too high (or, say, the percentage of lime carbonate falls below 75) a compound is obtained which, in the burning process, will fuse at a temperature lower than that required for the production of sound clinker, thus rendering it comparatively useless. On the other hand, an excess of chalk (above, say, 77 per cent.) will allow a mixture to sustain the highest temperature in the kiln without risk of fusion, but the resultant clinker would be of doubtful quality because of its high-liming or expansive tendencies when ground for cement.

Again, a variation in the amount of carbonate of lime, even to one-half per cent., is found to alter appreciably the tensile strength of a cement—namely, high lime increasing the strength, and low lime producing cement of little strength.

Analysis of Mixed Raw Materials

The chemically mixed raw materials prepared in the ordinary course of manufacture may, therefore, analyse in this way:—

Silica	16.5	Clay.
Alumina and Oxide of Iron	6.5	
Undetermined	..	
Carbonate of Lime	75.5	Chalk.
Carbonate of Magnesia	1.0	

From such a material, if properly treated in the further stages of manufacture, a good commercial cement, testing at least 600 lbs per square inch in seven days, should be produced. The raw materials after combination are then carefully mixed and proved before proceeding with the manufacture.

Burning or Calcining

The next stage in the manufacture of Portland cement, following the scientific and mechanical preparation of the raw material, is that of burning at a high temperature, or calcining, the raw product to the point of slight vitrification, resulting in what is commonly called a cement "clinker."

In the raw materials it will be observed that there is no combination between the carbonate of lime on the one hand, and the silicate of alumina on the other hand; in the conversion of the prepared raw materials into cement clinker by burning, the silica and alumina of the clay immediately enter into combination with the lime, thus forming calcium silicates and aluminates. These compounds are the important constituents of a Portland cement, and give to it, when combined in their proper proportions, its hydraulic properties. None of the cements of commerce, however, are made up wholly of these three ingredients, for the raw materials from which cement is made are never quite pure. It has been found, for instance, that iron oxide behaves, in burning a mixture, the same as alumina, and that a good cement could be made in which all the alumina was replaced by iron oxide, but the essential elements of a good cement are that it shall contain at least the necessary amount of silica and lime.

Heat Regulation

The calcining process is a purely chemical one, and it is a stage of the manufacture involving great responsibility, for, just as in the primary blending of the chalk and clay, a faulty mixing can make or mar the quality of the cement, so can the deficient burning of the material destroy all that is valuable in the finished product. If the heat be not sufficient, the necessary chemical changes do not take place, and a similar unsatisfactory result is obtained.

The proper degree of burning is indicated by the formation of a dense greenish-black clinker when coming from the kilns. Light-burned clinker is yellow and soft, while overburned clinker is fused and slag-like. Thermometric measurements made during the process of calcination show that for normal Portland cement burning, a temperature is required in the kiln amounting to about 1,400° Centigrade, or 2,500° Fahrenheit. The temperature is variable, according to the percentage of carbonate of lime contained in the raw materials—namely, the higher the proportion of lime the higher the temperature which is necessary to produce complete diffusion in combination with silica. Iron oxide also has the effect of reducing the clinkering temperature.

Types of Kilns

The kilns for burning the raw materials are constructed for either an "intermittent" or "continuous" process. The intermittent kilns now generally adopted are those employed in the wet process, and are of such a design that the burning necessitates distinct loading and drawing operations, giving intermittent working, and demanding the complete cessation of the burning process during the drawing operation.

In the continuous kilns, the burning of the raw material proceeds without a break, and the drawing of a clinker takes place at the same time without interruption, thus making a continuous process.

Continuous kilns are generally costly to construct and require skilled labor for their operation. They are economical in fuel, and where they are used the calcining processes are much more regular, and the cement is of better quality.

In the category of continuous kilns we come to the process of burning by the "rotary" kiln, which is the most modern appliance for calcination. The manufacture of cement by the rotary kiln may be said to have revolutionized the industry, and this method of burning the raw materials is, perhaps, the most scientific and practical invention that has been introduced into the manufacture since Portland cement was first known. Although the use of this kiln is a technical and expensive process, involving heavy capital outlay and high cost of production and continual upkeep, there is nothing yet in sight to outclass this invention in the manufacture of Portland cement.

Although the rotary kiln was the subject of much doubt and prejudice when first introduced, it is safe to say that no new cement factory would be erected at the present day without a rotary kiln. The rotary kiln consists of a slightly inclined steel or wrought-iron cylinder, usually from 100 to 200 feet in length, and 6 to 9 feet in diameter, and is inclined to the horizontal at about 1 in 30. The size of the kiln within these limits determines the quantity of the output—a rotary kiln 200 feet long, and 9 feet in diameter, producing some 1,200 tons of clinker a week, with night and day running. The rotary kiln is lined with radial firebricks, some 9 in. in thickness, and the long cylinder is mounted on tyres running on rollers, and is slowly rotated by gearing.

Rotary Process of Burning

The cement-making materials are continuously fed into the kiln through a pipe at the upper end in the form of either liquid mud (slurry) or dry powder, according to the process adopted in preparing and mixing the raw materials. Finely ground coal is almost always used as fuel, and this is introduced into the lower or outlet end by a jet of air issuing from a blast fan.

When the kiln is started the fine coal is ignited, and after a time a white heat is obtained in the lower end of the cylinder. The raw material is then fed into the kiln, and, as it gradually descends into the zone of heat generated by the perfect combustion of the finely ground coal fed into the cylinder from the opposite end it parts with its carbonic acid, forms little balls which reach nearly a white heat in the lower third of the kiln, and finally issues at the lower end as well-burned clinker in grains about the size of a large pea. The greatest heat is naturally near the fuel-jet, or outlet end of the kiln.

The operation of calcining is a continuous one, and with proper care under or over burning may be avoided. The hot clinker is cooled by passing through rotary cooling drums similar in construction to the rotary kiln but much smaller in size.

Cooling Drums

The cooling drums now generally in use in the country are placed at the lower end of the kiln, and receive the hot clinker as it drops finally from the kiln. The coolers generally consist of tubes some 40 feet long and 4 feet in diameter, containing cascading channels for lifting and dropping the hot clinker as the coolers rotate, thus presenting it to the cold air passing through the cooler on its way to the kiln. The coolers rotate at a somewhat higher speed than the furnace tube, and by the air for the latter being drawn through the red-hot clinker a fair proportion of the otherwise lost heat is retained and utilised. When the clinker passes from the coolers it is quite cold enough to handle, and to pass to the further process of grinding into powder.

The first stage in the reduction of the clinker is generally carried out by an ordinary stone-breaker or crusher, or by rolls, which reduce any large lumps to sizes from about ⅜-inch cube down to coarse dust, and after this operation the clinker is conveyed to the fine grinding machinery.

In modern works the preliminary grinding of cement clinker is carried out by the ball-mill, and from this mill the coarsely ground material is conducted to a tube-mill which finishes the fine grinding previous to storing the cement. The ball-mill consists of a cylindrical grinding drum, mounted on a steel shaft running through it, and provided with a tightly-closed sheet-iron casing. The grinding drum is composed of overlapping steel grinding plates, in one-half of which are holes for the ground material to find its way through to the fine sieves externally surrounding the drum, and through which the somewhat coarsely ground cement passes and is conveyed to the tube-mills for finer grinding. The crushing action of the ball-mill is caused by the revolving of the drum, which contains a number of steel balls of various sizes between which the clinker is crushed and pulverized.

For the finishing process—the fine grinding proper—the tube-mill is employed, which grinds by means of the round flint stones or steel pellets contained within it.

The tube-mill consists of a wrought iron revolving cylinder, with hollowed out pivots at both the feed and delivery bearings, and is about one-half full of rounded flint stone, for other grinding medium. The coarsely ground cement is fed from the ball-mill into one end of the tube-mill, and the rotary action of this mill, similarly to the ball-mill, finely pulverizes the cement as it passes through the falling flint stones to the delivery end.

The finished cement is ground sufficiently fine to pass through a 180 x 160 mesh sieve with about 10 per cent. residue, and finer grinding can be readily accomplished by the manufacturer if necessary; but this means a reduced output from the plant.

From the grinding mills the cement is conveyed into the stores, and after it has cooled down the material is ready for loading out at the factory.

New Substation of the Mount Royal Tunnel and Terminal Co., Ltd.

The Mount Royal Tunnel and Terminal Company, Limited, are constructing on a site on Douglas Road and Canora Street, Mount Royal Model City, a terminal sub-station in connection with the Mount Royal tunnel. Power will be purchased and brought into the station, which is just outside the west portal, through cables in duplicate running in ducts through the centre wall of the tunnel from the Dorchester Street terminal.

The building is 92.6 x 76 ft., and 43. ft. in height. It consists of two sections, one being the main machine room and the other consisting of rooms for various auxiliary machines. The machine room is separated from the others by a brick wall running through the centre of the building, communication being by means of two doors. The chief machine room occupies the front portion, and the remaining rooms are at the back, and are divided into three storeys. The motor generator sets will be placed in the main room, which has a floor space of 4,000 feet, and will be equipped with a travelling crane running the entire length of the room, and carried on steel posts, stanchions, and beams. The concrete floor, 12 inches thick, will carry hundreds of iron conduits in which will be placed the various wires.

On the same level as the main room and at the back are the bus bar room, feeder entry room, and the power transformer rooms. Above these are the oil switch room, the lightning arrester room, and the signal and lighting transformer rooms. On the third floor are situated the oil switch control batteries and the upper part of the lightning arrester room. In the basement the oil room, bunkers, etc., are located.

The foundations and floors are of concrete. The exterior is of tapestry brick with trimmings of patent stone made by the company. The windows have steel sashes and rough rolled plate glass. The roof of concrete is carried on steel trusses, with a clear span of 44 feet.

The walls of the machine room are lined with a glazed brick dado to a height of 10 feet from the floor; above this, the walls are lined to their full height with cream pressed brick. The whole of the backing of the internal cross walls is of plastic brick. The transformer and battery rooms are ventilated by means of shafts, while the machinery room has a special system of ventilation, the ventilators measuring six feet across. The interior doors are of iron or steel Kalamine. The company are carrying out the construction work themselves. The Metal Shingle and Siding Company, Limited, Montreal, executed the roofing; Steel and Radiation, Limited, Toronto, supplied the metal sashes and boilers for heating; the James Walker Hardware Company, Montreal, the hardware; and Dartnell, Limited, Montreal, all the brick except the plastic, which was made by the National Brick Company of Laprairie, Limited.


View of the Substation at Mount Royal Model City.

There was a great deal of optimism shown at the annual meeting of the Builders' Exchange, recently held at Saskatoon, Sask., and the general opinion seemed to be that the building outlook for the present year is brighter than it has been for a considerable time. Among the officers appointed for the year were: President, Jas. Priel; Vice Presidents, A. W. Cassidy and A. E. Richardson; Hon. Treas., A. Rutherford; Secretary, M. R. Pout.

Some Comparative Values and Costs of Different Types of Street Pavements and Roads

Considerable has been published on different types of street pavements and roads from the point of view of the method of construction. The following paper by E. M. Le Qua, in "Engineering and Contracting," gives some comparative values of various approved forms of street pavements:—

The life of a pavement is determined by two wholly different factors or a combination of the two—natural durability of the materials of which the pavement is constructed, and the amount of punishment the pavement receives due to wear, tear and age. The destruction due to age is independent of that due to travel. The statement that a certain pavement has lasted a certain number of years means practically nothing as regards its durability unless the quantity of travel, preferably in tons, per square yard, per year is given. To the neglect of this principle is due the conflicting statements about the durability of various kinds. From the point of economy alone, the following factors must be taken into account in comparisons:

(1) First cost.

(2) Interest on first cost.

(3) Payments to sinking fund to redeem debt incurred for construction.

(4) Maintenance cost including cleaning and watering.

(5) Useful life of the pavement.

(6) Value of the worn-out pavement for purposes of renewal.

Maintenance consists of the following separate divisions besides the cost of watering:—

(a) Interest on first cost.

(b) Annual payment to a fund to redeem bonds in (x) years at (x) per cent. interest.

(c) Annual payment to a sinking fund to provide sum necessary for reconstruction at the end of (x) years.

(d) Cost of ordinary repairs during life of pavement per square yard per year.

(e) Cost of cleaning per square yard per year.

(f) Total cost per square yard per year.

This latter comparison is for an annual check and is entirely separate from the one above. Compared on this maintenance basis in the city of Boston:—

	Life.
Granite blocks, cost annually, $0.58 per sq. yd.	13 yrs.
Sheet asphalt, cost annually, $0.57 per sq. yd.	9 yrs.
Macadam, cost annually, $0.78 per sq. yd.	5 yrs.

It was found that pavements are often continued in use long after it would be more economical to renew than to repair.

Although cost is the great item in pavement comparison the public in general demands that many more things be taken into account and the following pavements will be compared on the basis of the essentials of a perfect pavement, namely:—

(1) Cheapness. No matter how good a pavement is unless the money for its purchase is at hand, it is not available. So the question is, what is the best obtainable with the money you have.

(2) Durability. Some materials have only a certain life whether they are subjected to traffic or not, such as asphalt and untreated wood. Where traffic is the governing factor, it, in turn, is influenced by width of street, character of pavement, presence or absence of street cars, and state of repair.

(3) Ease of Cleaning. An economic and sanitary factor.

(4) Resistance to Traffic. Pavements are constructed for the transportation of vehicles and anything hindering this is important.

(5) Non-Slipperiness. The efficiency of a horse depends on his foothold. Infinite strength is of no avail if there is no place to apply it.

(6) Maintenance. Closely allied to first cost and depending on material and traffic. With some pavements, as treated wood and asphalt, a certain amount of traffic is more beneficial than otherwise.

(7) Favorableness to Travel. Ease and comfort of riding and decrease of wear on vehicles.

(8) Acceptability. Lack of noise, reflection of light, radiation of heat, emission of unpleasant odors and other qualities concerning the pedestrian and adjoining residents.

(9) Sanitary Quality. An essential to health in any city.

Sheet Asphalt

This type of pavement is suitable for use, with a proper foundation, for medium to heavy traffic, and in some parts of Canada is used and proposed, with a 6-in. concrete base, for very heavy traffic. It is not suitable on grades steeper than 5 per cent. as a general rule, but has been used on 7 per cent. grades. It wears fairly even, with a tendency towards ruts and holes under heavy traffic. Its advantages are ease of traction, smoothness, comparative noiselessness under traffic, impervious to water, easily cleaned, pleasing to the eye, suitable to practically all classes of traffic, no vibration or concussion given to passing vehicles, and comparative low first cost and maintenance. Its disadvantages are, slipperiness under certain atmospheric conditions, disintegrates if excessively sprinkled or otherwise subjected to constant moisture, although asphaltum is impervious to either fresh of salt water, becomes soft and wavy under traffic in extreme heat, may crack and become friable under extreme cold, and is not adapted to steep grades.

In 1911, 2,348 mi. of asphalt sheet were laid in Brooklyn, Boston, Buffalo, Chicago, New York, Philadelphia, St. Louis, and Washington, D.C. Chicago, Washington, Philadelphia, New York, and Winnipeg, Canada, have more than of any other type. Maintenance costs vary from $.35 per sq. yd. in Brooklyn to $.30 per sq. yd. in London, depending on age and traffic. When properly constructed, asphalt is good for a life of from 16 to 22 years.

Asphaltic Concrete

Suitable in most places where sheet asphalt is used and in some where it is not. Has been used satisfactorily on grades of from 2 per cent. to 7 per cent. with transverse, staggered grooves cut for a foothold on the latter grade. Is slippery in wet weather, with tendency to wear into holes under heavy traffic. Slightly noisier than sheet asphalt, with a life depending mainly on the toughness of the stone aggregate. Cost values are from $1 to $2.50 per square yard, the latter including grading and foundation.

Asphaltic Macadam

Generally proposed where traffic is not quite heavy enough to necessitate sheet asphalt, with the same foundation as the latter. It may take the place of sheet asphalt on grades greater than 5 per cent. In Canada it is often laid on Telford base, consisting of stones 8 in. thick laid on edge.

Costs vary from $.77 in Baltimore to $1.36 in Ontario.

Advantages are freedom from dust, low external and internal wear on road metal, imperviousness and a degree of density of surface, noiselessness, low traction resistance, and is sanitary. Disadvantages are slipperiness at times and variability of penetration and distribution of road metal.

Asphalt Block

This type affords a better foothold than sheet asphalt owing to a coarser stone in the aggregate and on account of the joints between the blocks. An objection is that the blocks have to be all manufactured at one location and transported to the locality where used while a portable sheet asphalt plant permits a smaller haul. This is counteracted in repair, however, where the removable blocks allow an easy reconstruction without necessity of a resurfacer or mixing plant.

Suitable for residence streets of light traffic minus car tracks, with a profitable life of ten years. Cost of construction averages $2.70, with maintenance from $.062 to $.10 per square yard. The pavement is very hard to keep clean when roughened and worn at edges.

Wood Block—Treated

An ideal pavement where traffic is heavy and noise a detriment. Except for its high cost and a tendency toward slipperiness when wet it is suitable for streets with all degrees of traffic. Cost from $2.50 to $3.50, including grading. Maintenance cost from $.014 to $.26. It wears very evenly and has a life of from 10 to 20 years.

Advantages are noiselessness, long life, smooth, easily cleaned, and sanitary. Disadvantages, tendency to slipperiness in wet weather and to bleeding and warping in hot weather due to improper treatment or laying.

Brick

This type is good under all conditions as far as durability is concerned when made of a good quailty product. It is noisy and should not be used where noise is a detriment. With lugs, it can be laid on fairly steep grades. It is not easy to broom, but cleans readily with a flusher. Advantages, durability, slight resistance to traction, dustless, and furnishes good foothold. Disadvantages, large coefficient of expansion, noisy, and tendency to edge wear producing cobbles and holes. Life with heavy traffic and car tracks, 8 years, without tracks, 15 years. Costs $1.85 to $2.95, with a maintenance cost not generally exceeding $.02 per year unless it is treated with a bituminous coat.

Concrete

Its life is not as long as that of brick, but when properly constructed concrete is capable of rendering service fully commensurate with its cost of construction. Costs are quite modified by local conditions, but generally average about $1.85 per square yard. Most of it would admit of resurfacing after 15 years. On several jobs in Illinois five year serial bonds, payable annually, were issued which gave a total cost at the end of a 25-year life, including first cost, interest and maintenance of $3.19 per square yard per year. Concrete is smooth, easy to clean, and gives a good foothold when surfaced, but is dusty, slippery, and noisy without a bituminous coat.

Stone Block

Is very good where the traffic is of the heaviest and most destructive type. When the blocks are so used they should be specially selected and tested. Granite and quartzite are usually used, but the choice of kind should be governed by the availability. With a concrete foundation, well dressed and close jointed blocks of small size, a life of 30 years is not uncommon. The average cost with a grout filler is $3.50 per square yard, with a meintenance of $.001 to $.02 per square yard. The pavement is durable, adapted to grades, and easy to clean when smooth, but is slippery, noisy, rough and unsanitary when worn.

Tar Macadam

This macadam has many advantages over water-bound, is less perishable, has a longer life, is practically noiseless, preserves a smoother surface, and requires less maintenance. The cost is a little more than that of ordinary macadam, but its increased life easily compensates for this, and it will take a considerably heavier traffic. It is not generally used on grades of over 1 in 30. Cost averages $.85 per sq. yd., with comparatively little maintenance. A patent of this type called Tarmac, using broken slag and tar mixed in a machine has been used to a considerable extent in England and has given good satisfaction.

Water Bound Macadam

This is suitable for light traffic in residence districts when treated with a bitumen or light oil, but without treatment soon ravels and becomes very dusty. Yearly maintenance is practically necessary at a cost of from $.04 to $.12, depending on the treatment. First cost depending on locality, varies from $.50 to $1 per square yard. Below are given the opinions of a group of prominent Canadian engineers as to:

1.—Place for Pavements in Order of Popularity

(1) Light residence to semi-business: sheet asphalt, bitulithic, asphaltic concrete, wood block, asphalt block, concrete.

(2) Semi-business to medium heavy traffic: bitulithic, sheet asphalt, asphaltic concrete, wood block, asphalt block, concrete.

(3) Heavy traffic: brick, wood block, stone, scoria block.

(4) Along street railway tracks: wood block, brick.

(5) For quiet streets: wood block, bitulithic, sheet asphalt, concrete.

(6) For graded streets: brick.

2.—Nature of Deterioration

Asphalt Block: edge wear, forming holes and cobbles, noisy and hard to keep clean when worn, disintegrates at bottom.

Asphaltic Concrete: wears into holes, susceptible to marking in hot weather.

Bitulithic: wears evenly, tendency to holes under heavy traffic.

Brick: edge wear and cobbling under heavy traffic, increased noise and unsanitariness as wear increases, slows down traffic when badly worn.

Sheet Asphalt: wears slowly into large holes or patches, heavy traffic causes ruts, cracks hasten deterioration.

Wood Block: rots if untreated, when treated wear is slow and even.

Stone and Scoria Block: wears gradually into holes and cobbles, unsanitary when rough.

Concrete: wears slowly and evenly if well made, otherwise cracks and chips.

Below are given various tabulations of camparison, compiled from data available:—

I.—USUAL LIFE OF PAVEMENTS.—J. B. HITTEL, CHIEF ENGINEER, CHICAGO.

Asphalt	12 to 15 years
Brick	12 to 15 years
Wood block	15 to 18 years
Granite	30 to 40 years

II.—MOST ECONOMICAL PAVEMENT UNDER CONDITIONS.

(a) Large volume of heavy traffic.

(b) Secondary business streets with moderate volume and weight of traffic.

(c) Main city or suburban streets having large volume of light traffic.

(d) Suburban or residence streets where traffic is local and light.

For (a) macadam is most expensive, sheet asphalt slightly better than granite, but granite is preferable owing to the inconvenience of repairs to asphalt.

For (b) macadam is the most expensive, sheet asphalt the most economical.

For (c) granite is most expensive and a material difference exists in favor of sheet asphalt over macadam, though the relative costs do not differ widely.

For (d) granite is very expensive, macadam the cheapest.

III.—FRACTIONAL RESISTANCE.

Asphalt	1 (least)
Macadam	2-5
Macadam (wet)	7-8

IV.—COSTS FOR PERIOD OF YEARS, ASSUMING GRANITE HAS A 25-YEAR LIFE, WOOD 20 YEARS, BRICK 15 YEARS, ASPHALT 18 YEARS.

Material.	First cost per sq. yd.	Exp. per yr. per yd., 1st period.	Aver exp. per yr. per yd., 50 yrs.
Granite	$3.50	$0.294	$0.270
Asphalt	2.00	.208	.164
Wood	3.50	.308	.274
Brick	2.50	.224	.199

V.—DURABILITY.

Material.	Small repairs. Years.	Extensive. repairs. Years.	Complete reconstruction. Years.
Asphalt black	5-10	10-12	12-15
Asphalt concrete	4- 6	6- 8	8-10
Bithulitic	5- 8	10-15	15-20
Brick	8-10	10-15	15-18
Concrete	5- 8	10-12	15-18
Stone—Scoria	10-15	15-20	20-30
Sheet asphalt	4- 8	10-15	15-18
Untreated wood	3- 5	6-10	10-12
Treated wood	8-10	12-15	15-18

VI.—GENERAL QUALITIES BY THE PER CENT SYSTEM.

Quality.	%.	Granite.	Wood.	Asphalt.	Brick.
Cheapness	14	8	8	11	11
Durability	21	21	16	15	16
Ease of cleaning	15	10	14	14	15
Light traffic resistance	15	13	14	12	15
Non-slipperiness	7	7	4	5	6
Ease of maintenance	10	10	8	6	6
Favorableness to travel	5	2	5	4	3
Sanitary qualities	13	9	13	12	10
Totals	100	80	82	70	82
Cheapness eliminated	..	72	74	68	71

VIII—GENERAL QUALITIES USING OTHER FACTORS.

	Per cent.	Granite.	Sand stone.	Sheet asphalt.	Block asphalt.	Brick	Macadam	Wood.
First cost	14	4	4	6.5	6.5	7	14	4.5
Durability	20	20	17.5	10	14	12.5	6	14
Ease of maintenance	10	9.5	10	7.5	8	8.5	4.5	9.5
Ease of cleaning	14	10	11	11	14	12.5	6	14
Low traction resistance	14	8.5	9.5	14	13.5	12.5	8	14
Non-slipperiness	7	5.5	7	3.5	4.5	5.5	6.5	4
[1]Favorableness to travel	4	2.5	3.5	4	3.5	3	3	3.5
[2]Acceptability	4	2	2.5	3.5	3.5	2.5	2.5	4
Sanitary quality	13	9	8.5	13	12	10.5	4.5	12.5
Total	100	71	73.5	76	79.5	74.5	55	80

[1]Refers to smoothness and freedom from dust and mud.

[2]To noise, reflection of light and heat, emission of unpleasant odors and other things concerning pedestrians and adjoining residents.

In conclusion would say that many more years must pass and accurate data be kept before a reliable comparison of pavement can be procured. In any pavement construction, great attention must be given to the supply of materials at hand. Also, since prices are generally going upward, it must be taken into consideration that the increasing cost of construction and maintenance is not due alone to an increase in the amount of traffic, but to a necessary increase in cost of materials in years to come.

New Report on Waterworks of Canada

A new edition of "Waterworks and Sewerage Systems of Canada," by Leo G. Denis, has just been issued by the Commission of Conservation. In the present report the various physical and financial data respecting waterworks have been brought up to date and a new section on sewerage systems has been added. The book is a royal octavo volume, handsomely bound in cloth, contains 176 pages of text and is well illustrated with 25 half-tones and 5 diagrams.

In the year of Confederation there were only 7 waterworks plants in Canada; to-day there are 528. These have been built at a total cost of $123,725,633, and entail an annual maintenance charge of $4,558,539. The total daily consumption is 426,877,000 Imperial gallons, which gives an average daily consumption per capita of 111 gallons, ranging from 50 gallons in Manitoba to 143 in New Brunswick.

There are 206 plants supplied from springs or wells and 322 from lakes or streams. In 72 plants the water is filtered and in 21 plants it is treated with hypochlorite. The municipally-owned plants number 396. As to rates, where specified, it is shown that flat rates are used in 209 cases, meters in 30, and both flat and meter in 141.

There are 279 sewerage systems in Canada, having an aggregate mileage of 4,223, and which have been built at a total cost of $74,504,418. In only 75 municipalities is the sewage treated. Proportionally to population, the West, with 28 treatment plants, makes a much better showing than the East, with 47. The total cost of the treatment plants is $3,218,935.

Harbor Development in New Brunswick

Tenders are being asked by the New Brunswick Public Works Department for crib-work and back filling on Pier 16, West St. John, the intention being to have this pier ready for next winter's port business. During the season just ended there was an occasional shortage of pier accommodation. With another pier built, this shortage will be to some extent removed. A temporary wooden warehouse will be erected on this pier. Three dredges are now operating at East St. John, preparing new terminals for the Canadian Government Railways.

Development work has been begun on the tungsten mines near Burnt Hill, Northumberland County, N. B. There is a great demand for this valuable ore.

The federal government has decided to erect a million bushel grain elevator at St. John, N. B., in connection with the Canadian Government Railway system. It is expected that the first unit of 500,000 bushels will be ready for use the coming winter season.

The contract for the construction of the St. John Valley Railway from Gagetown to Westfield has been awarded to the Nova Scotia Construction Company of Sydney, N. S. The contract provides that the road shall be completed in safe condition for operation by February 1st, 1917, and the work fully performed August 1, 1917. This section of railway is to be employed in bringing Transcontinental Railway freight to St. John, the C. P. R. track being used temporarily between Westfield and the city. Until the East St. John terminals are completed, export freight will be shipped from West St. John.

Concrete in Tree Surgery

IN the science of medication of members of the vegetable kingdom, quite an important part is played by concrete. This material has in the practice of surgery a well defined purpose and a certain fixed method of application. Cement in trees fulfils the threefold purpose of stopping decay, serving as a structural support, and providing a surface over which the bark may heal.

The real life of a tree is represented by the bark, a cambium layer just behind it, two, three or four inches of sapwood behind the cambium layer, and the leaves and roots. The inside of a tree is practically dormant. The sap ascends in the outer woody fibre, enters the leaves, undergoes its chemical change which produces the tree food, and descends just inside the bark, building as it goes. The central tissues serve no purpose save physical support.

Decay in a tree attacks and disintegrates the dormant fibre first. The life of a tree affected with decay may be prolonged for some time by removing the decaying material and replacing it with cement. After removing the decay, any remaining fungi—which are the direct cause of decomposition—may be killed by a coat of corrosive sublimate. The cavity is then waterproofed with a penetrating and adhesive waterproofing material and the concrete applied.

Cement improperly put in a tree is worse than none. Sometimes it is necessary to put the cement in in sections, leaving joints to permit of the tree swaying without damaging the joint. The exclusion of foreign substances, especially water, is the all-important task of the tree surgeon. Some sort of waterproofing is applied around the edges of the cavity, which will exclude moisture and still allow the bark to grow over and cover the wound.

Nature responds wonderfully to proper treatment. Save the trees—they provide to the human family comfort, beauty, and pleasure, they hold in check the water that forms our rivers, thereby insuring a more uniform flow, besides contributing in other manifold ways to the well-being of man.

Crusher Parts Wanted

A contractor in the Maritime Provinces wants to get in touch with any Canadian firm carrying in stock parts for the Broadbent Rock Crusher. The name can be obtained from the publishers of this journal.

In the opinion of Mr. Paul Mercier, chief engineer of the city of Montreal, paving of streets can be done more economically by day labor than by contract. This opinion was based on a comparison of prices on work done last summer. Mr. Mercier, however, made an exception in the case of the construction of asphalt sidewalks.

Protecting the Owner and Architect

Toronto, Ont., May 11, 1916.

Editor Contract Record:

I noticed a most interesting article in The Contract Record of April 19th, written by Mr. G. Alexander Wright, entitled, "Bids, Bidders, and Bidding," and which asks for suggestions from the readers of The Record which will correct certain evils that have crept in in this connection.

As I feel that a word from the standpoint of the Bonding Company might be apropos, I take this opportunity of replying to the invitation extended by Mr. Wright.

Summing up Mr. Wright's article, as I see it, a responsible contractor, and by responsible contractor I mean a contractor who is competent and capable of handling any contract he tenders for, "inasmuch as his figures will be carefully compiled and allowances made for a fair profit on the contract," hesitates to bid because he is competing with irresponsible contractors who are inexperienced and who therefore do not figure as carefully or as conscientiously, their main idea being to secure the contract with the hope that they may be able to complete the contract profitably. To be explicit: they have everything to gain and nothing to lose for the price they submit.

The question therefore resolves itself into how can the owner and architect protect themselves against the tendering of irrsponsible contractors without experience and without sufficient financial standing to back up their tender.

The answer is simple. You have at your disposal a quick remedy, by inserting in your specifications the following clause:—

> "The Contractor shall furnish with his tender the consent in writing of a guaranty company authorized to do business in Canada, to issue a contract bond on his behalf, guaranteeing the faithful performance of the contract in an amount equal to 20 per cent. of the amount of the contract, and contractors proposing to tender will make immediate arrangements with their guaranty company for such bond, as the companies require sufficient time to complete inquiries."

This will compel every contractor tendering on the work, obtaining a bond from some guaranty company, who is prepared to back up his tender by their financial resources, guaranteeing that if the contract is awarded to him he will sign the contract and that he will carry out the contract according to the terms and conditions, plans, specifications of the contract. If this plan is adopted you eliminate the inexperienced, irresponsible contractor, without any financial backing, from tendering on the work and get down to the only class of contractor which the owner and architect want to deal with. There are a sufficient number of responsible contractors to still leave the question of price on a competitive basis and this arrangement places no hardship on any contractor who can do the work. He simply arranges with his bonding company for a bond the same way he would arrange with his banker for a line of credit. It relieves the architect and owner of the work of ascertaining whether they are letting the contract to a financially responsible contractor or not, and also whether he is competent in the line of work on which he is tendering, and it does not legislate against the smaller contractor because any contractor, be he big or little, who is responsible and bears a good reputation, can secure credit from a guaranty company up to the amount which they consider he has had the experience and financial responsibility that they can safely back him up for.

In conclusion, let me add that the first protection to the owner and architect is the manner in which the guaranty company carefully considers every contractor's application. Every application is dealt with separately and entirely on its own merits. The moral, as well as the financial standing of the contractor, is taken into consideration along with his ability in the line of work to be undertaken, and it is only after every point is carefully considered that the bond is either accepted or refused.

I wish to thank you for the opportunity afforded me of putting these suggestion to you and hope that they will be considered worthy of publication and trust that you will consider that this article is written entirely from an educational standpoint.

Yours very truly,

Sidney W. Band,
Assistant Manager.
United States Fidelity and Guaranty Co.

Mainly Constructional

East and West—From Coast to Coast

Messrs. Henderson & Taylor were recently appointed municipal engineers at Matsque, B.C.

A brick plant at Cardwell Junction, Ont., which has been closed for some time, will resume operations shortly.

The Maisonneuve Quarry Company has been incorporated with a capital of $45,000, headquarters at Montreal, P.Q.

The Canadian Construction Company, Limited, has been incorporated with a capital of $90,000, headquarters to be in Montreal, P. Q.

The Vulcan Asphalt & Supply Company, Limited, have been incorporated with a capital of $10,000, headquarters at Winnipeg, Man.

The Sanitary Heating and Ventilating Company, Limited, have been incorporated with a capital stock of $50,000. Their headquarters are to be at Ottawa, Ont.

P. Lyall & Sons, Construction Co., Montreal, have received a contract for the reconstruction of the Parliament buildings at Ottawa at approximately $6,000,000.

The Arnot Construction Company, Limited, has been incorporated with a capital of $40,000. The head office of the company will be in Toronto, Ont., and its provisional directors will be David Arnot, Oliver Rouse and John Billington Nicholson.

Amongst buildings for which permits were issued recently in the city of Quebec are two novitiates, one for the Christian Brothers of the Commercial Academy, amounting to $237,000, and the other for the Fathers of the Sacred Heart, to cost $68,000.

A large factory for the manufacture of oxygen and liquified acetylene is to be erected in Winnipeg by a prominent Montreal firm of chemists, on property situated between Wellington and Sargent Avenues, and extending through from Spruce to Pine Streets.

A handsome addition to the public buildings of Sydney, N. S., is a new hospital which is now practically completed. It is a beautifully designed structure built of the best quality pressed brick and is designed and finished throughout on the most modern lines of hospital architecture and construction.

Letters patent of incorporation have been granted to Messrs. Luther B. Smith, of St. John, N. B., E. Lorne Merrithew, of Fredericton, and J. Everett Fenwick, of Millstream, as Smith-Merrithew, Limited, to carry on general contracting business, with a capital stock of $49,000. The head office is at St. John.

The formal opening of the Public Utilities Commission's new offices at Dundas, Ont., took place recently. The building, which was erected by the Dickson Building Company, is of red brick, and is very handsome and well fitted. It is the first chimneyless office building in Ontario, being entirely lighted and heated by electricity.

Work on the Quebec bridge has been progressing rapidly this spring and already two panels have been added to the cantilever arm on the south side. The setting of steel for the suspended span being erected at Sillery has just been started, and according to the superintendent of the bridge, Mr. W. D. Fortune, everything will be in readiness to place the middle span in position by the first week in October, which will virtually complete the structure, making it one of the longest spanned bridges in the world.

A resolution favoring the extension of the Toronto-Hamilton Highway on the Lake Shore Road to a width of 86 feet, and the expropriation of extra land required to widen the roadway was recently passed by the council of Mimico, Ont. This, with similar resolutions from Port Credit and New Toronto councils, will terminate the uncertainty and delay regarding the construction of the highway.

Steel shipbuilding on a large scale has been started in Nova Scotia by the Nova Scotia Steel Company, which is commencing operations at New Glasgow near the plant of the Eastern Car Company. Steamers are to be built for the steel company itself at first, in order to supply the need for additional ocean tonnage. It is probable that shipbuilding in time will prove an extensive part of the company's activities.

Messrs. Quinlan & Robertson, contractors, presented a claim last February to the Orillia Water, Light and Power Commission for upwards of $30,000 in connection with the construction of Ragged Rapids dam, claiming that unexpected conditions at the bottom of the river had occasioned this extra expenditure. The matter has been settled, however, without litigation, on the payment of $7,500 by the Commission to the contractors.

At a meeting of the directors of the Trusts and Guarantee Company, Limited, held recently, it was decided to proceed at once with the erection of a new $500,000 office building on Bay Street, Toronto. Tenders have already been received and contracts will be let immediately. Messrs. Curry and Sparling, architects, have designed the building, and it will be a most distinctive and attractive structure. It is to be eight storeys in height, including basement, with provision for addition of five more storeys at a later date. The front is to be of grey Indiana limestone, with a Stanstead granite base. The main floor will be handsomely finished in French Tavernelle marble. The building will be absolutely fireproof and will contain all the latest improvements in equipment, including the newest type of ventilating system. In size it is 50 x 95 feet. It is expected to be ready for occupation by January 1, 1917.

Obituary

Elmer Lawrence Corthell, D.Sc., President of the Am. Soc. C. E., consulting engineer, bridge and railway builder, river and harbor expert, and a member of numerous scientific societies, died recently at Albany, N. Y.

Lieut. C. S. D. Ross, of Calgary, was recently shown on the casualty lists as killed in action. Lieut. Ross came to Canada from Cheshire, England, and was for some time engaged as civil engineer with the C. P. R., being well known along the line. He left with a Calgary engineer battalion early in the war, and had been in the trenches for over a year.

Lieut. Trafford Jones, who practised as a civil engineer in and about Toronto for some eight years and enlisted last May with the Canadian Army Service Corps, met his death near Ypres during an aerial battle with German aviators when he was shot through the head. He was 29 years of age, and leaves a wife and child, both of whom are in England at present.

Trade Publications

Fire Hose and Accessories—Catalogues F. 2 and J. 1, by the Dunlop Tire & Rubber Goods Co., describing Dunlop fire hose and accessories—the latter for every class of building. Both of these catalogues are splendidly illustrated. The same firm are also distributing an interesting and valuable catalogue on Dunlop mats and matting, inlaid and plain rubber flooring.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Bassano, Alta.
Tenders are now being received on the supply of about 1,000 feet of vitrified sewer pipe and 1,000 feet of cast iron or steel pipe and specials. Town Engineer, G. W. Murgatroyd.

Dundas, Ont.
The Town Council will shortly call for tenders on the construction of about 5,000 feet of sidewalks. Estimated cost, $5,500. Clerk, J. S. Fry.

Edmonton, Alta.
The City Council propose to expend $12,000 on the construction of plank sidewalks throughout the city. Engineer, S. Haddow.

Hamilton, Ont.
Tenders will be received until June 17th for the construction of a drainage system for the City Council. Estimated cost, $35,000. Engineer, A. F. Macallum.

Morrisburg, Ont.
The Village Clerk, F. R. Chalmers, will receive tenders until 6 p.m., June 5th, on the construction of about 14,600 square feet of granolithic sidewalk.

Simcoe, Ont.
The Town Council are having plans prepared for the construction of about 3,000 feet of earthenware sewers and laterals. Engineer, Guy Marston, Norfolk Street.

St. Hyacinthe, Que.
Tenders on the construction of gravity filters for the City Council will be received until June 28th. Plans and specifications at office of the Clerk, A. Messier. Approximate cost, $75,000.

St. Pierre de Lac, Que.
The Municipal Council are considering the construction of waterworks, at an approximate cost of $10,000. British Columbia stave pipe may be used. Secretary, J. H. Langlais, Val Brilliant.

The Pas, Man.
Tenders will be received by the Town Secretary for the following work:—(1) supply and delivery of two sewage lift pumps; (2) construction of sewage lift chamber. Plans and specifications at office of the Consulting Engineers, Murphy & Underwood, Saskatoon, with the Resident Engineer, The Pas, and at office of the Contract Record, 347 Adelaide Street W., Toronto.

Tilbury North, Ont.
The Township Council are considering the construction and improvement of a number of tile drains.

CONTRACTS AWARDED

Markham, Ont.
The general contract for the construction of 35,000 square feet of concrete sidewalk has been let to John Hare.

Sombra Township, Ont.
The Township Council have let the contract for construction of the Murphy Drain to H. Dickson, at $1,800, and the Arnold Drain to George Hunter, at $2,050.

Toronto, Ont.
The Board of Control have awarded contracts for the construction of sewers to Murphy & Barnes, 23 Temple Avenue, at $6,889, and to the Commissioner of Works, $3,265.

Railroads, Bridges and Wharves

New Brunswick Province
The Provincial Department of Public Works, Fredericton, will receive tenders until June 7th for the construction of a steel truss bridge over the Aroostook River Mouth. The time for receiving tenders on three other bridges has also been extended to the same date.

Ottawa, Ont.
The Ottawa Electric Railway Propose to construct a bridge at Rockliffe Park, estimated to cost $6,000. Concrete and steel construction.

Toronto, Ont.
Bowman & Connor, Engineers, 31 Queen Street W., will receive tenders until June 2nd on the construction of ten bridges for the County of Wellington and one bridge for the Township of Maryboro.

CONTRACTS AWARDED

Fredericton, N. B.
The contract for building the uncompleted portions of the St. John-Quebec Railway has been let to the Nova Scotia Construction Company, 159 Upper Water Street, Halifax, N.S. Approximate cost, $1,750,000.

Public Buildings, Churches and Schools

Colchester North Township, Ont.
The Township Council propose to build a new school to replace that recently destroyed by fire. Approximate cost, $3,500. Clerk, M. W. Heaton, School Section No. 6, Essex.

Ford City, Ont.
Tenders on the erection of a school will be received until June 15th. Architect, J. C. Pennington, La Belle Building, Windsor. Brick and reinforced concrete construction. Estimated cost, $35,000.

Fort William, Ont.
The Ruthenian Congregation propose to build a church on Mountain Avenue, at an approximate cost of $5,000. Architect, W. Krinzonowski, 909 Superior Street. Frame construction.

Hull, Que.
Charles Brodeur, Architect, 63 City Hall Street, Hull, is preparing new plans of a convent for the Grey Nuns of the Cross, Ottawa, and will shortly call for tenders. Limestone and brick construction. Approximate cost, $24,500.

Kingston, Ont.
The Kingston Veterans Association have had preliminary plans prepared for a Soldiers' Home, estimated to cost $35,000. Architect, E. R. Beckwith, Cooper Street. Hollow tile and stucco construction.

Parry Sound, Ont.
Tenders on the erection of a school will be received until 6 p.m., June 12th, by the Secretary to the Board of Education. Plans and specifications at offices of the Architects, Angus & Angus, North Bay, the Contract Record, 347 Adelaide Street W., Toronto, and the Secretary. Approximate cost, $35,000.

Sault Ste. Marie, Ont.
Plans for alterations and additions to the Furse Business College are being prepared by Meridith, Findlay & Hazelgrove, 473 Queen Street E. Approximate cost, $7,000.

St. Louis de Pintendre, Que.
L. Auger, Architect, 39 St. Jean Street, Quebec, is preparing plans of a Presbytery for the Parish. Brick construction. Estimated cost, $10,000.

Toronto, Ont.
Plans of a convent to be built on a site adjoining St. Augustine's Seminary on the Kingston Road are being prepared by A. A. Post, Brisbane Building, Buffalo, N. Y. Brick, concrete and steel construction.

Welland, Ont.
Brigadier G. Miller, Salvation Army, Albert Street, Toronto, is preparing plans of a barracks estimated to cost $5,000. Brick construction.

CONTRACTS AWARDED

Amaranth Township, Ont.
The general contract for the erection of a school has been awarded to L. C. Hughson, Horning Mills, at $2,850, and the contract for construction of basement to W. Steward, Waldemar, Ont.

Antigonish, N.S.
The general contract for the erection of an addition to Mount St. Bernard's Ladies College has been awarded to Neil McNeil, Boston, Mass. Work will be superintended by John McLellan, Antigonish. Brick and steel construction.

Belleville, Ont.
The following contracts have been let in connection with the erection of a Children's Home:—electrical work, W. J. Carter, 279 Front Street; cut stone, J. McDonald, Point Anne, Ont.; brick, Hill Brick Company, Madoc, Ont.; hollow

tile, Sun Brick Company, Ltd., Traders Bank Building, Toronto; wood trimming, Knight Brothers Company, Limited, Burk's Falls, Ont.

Cartierville, Que.
In connection with the church basement now in course of erection for the Roman Catholic Congregation, the contract for wall furring and partitions has been let to the Montreal Terra Cotta Company, Limited, Board of Trade Building, Montreal.

Cochrane, Ont.
The contracts for masonry, roofing, carpentry, plastering and interior fittings required in the erection of a School have been let to the general contractor, the heating and plumbing to C. Giles, electrical work to M. Reed, and painting to Walbourn & Davidson, North Bay.

Kinburn, Ont.
In connection with the erection of a school, the contract for concrete work has been let to J. A. McAlister, 153 Sunnyside Street, Ottawa, and the heating and tinsmithing to the Capital Hardware Company, Bank and Fifth Streets, Ottawa. Plastering by general contractor.
ad BUSi buildings awarded ... ...

Montreal, Que.
The contract for partitions and wall furring required in the erection of a Presbytery for the Roman Catholic Parish of St. Catherine has been awarded to the Montreal Terra Cotta Company, Limited, Board of Trade Building.

The Montreal Terra Cotta Company have also been awarded the contract for terra cotta floor arching and wall furring in connection with the church basement now being built for St. Jean Berchmans Parish.

In connection with the school and residence now in course of erection for the Roman Catholic School Commissioners of Cote des Neiges, the plastering contract has been let to Rochefort & Normand, 108d Stadacona Street, and the painting to S. A. Lanctot, 478 Marquette Street.

The contract for brick work required in the erection of an oratoire for the Corporation of Notre Dame College has been let to Evariste Rochefort, 258 Nicolet Street, the plastering to Rochefort & Normand, 108d Stadacona Street, and the painting to S. A. Lanctot, 478 Marquette Street.

The Roman Catholic School Board have awarded the general contract for the erection of a school on Robin Street to L. Beaudry, 2420 Hutchison Street, at $136,000, and the heating to T. Lessard & Son, Craig Street E., at $11,600.

Ottawa, Ont.
The general contract for rebuilding the Parliament Buildings has been awarded to the Peter Lyall & Sons Construction Company, 120 St. James Street, Montreal. Estimated cost, $6,000,000.

Toronto, Ont.
The following contracts have been awarded for the erection of a Church and Sunday School for the Congregation of Pauline Avenue Methodist Church:—masonry, J. R. Page, 18 Toronto Street; carpentry, T. J. Sproule, 54 Shanley St.; roofing, A. Matthews, Ltd., 256 Adelaide Street W.; wiring, H. J. Ferguson, 36 Salem Avenue; plastering, J. Malton, 31 Brock Crescent. Approximate cost, $35,000.

Westboro, Ont.
The contract for roofing and plumbing in connection with the school now being built has been let to McKinley & Northwood, Rideau Street, Ottawa.

Business Buildings and Industrial Plants

Essex, Ont.
E. C. Dennert, care of Hill Brothers, proposes to build a factory for the manufacture of auto tractors.

Fort William, Ont.
H. Russell, North Syndicate Avenue, is preparing plans of a store to be built for G. A. Graham, Graham & Horne Block. Brick and concrete construction. Estimated cost, $5,000.

Lachine, Que.
The Dominion Bridge Company, Limited, are building an extension to their copper mill, estimated to cost $10,000, and a new forge shop at an approximate cost of $7,000. Brick, steel and corrugated iron construction.

London, Ont.
The West Floral Company contemplate the erection of an addition to their store and a new garage, at an approximate cost of $4,000. Manager, Emery Hamilton, 249 Dundas Street.

Medicine Hat, Alta.
Plans are being prepared for the erection of a mill for the Lake of the Woods Milling Company. Estimated cost, $500,000. Engineer, John Goldie, Keewatin, Ont. Brick and concrete construction.

Saskatoon, Sask.
Brown & Vallance, Architects, 120 Bleury Street, Montreal, have prepared plans for greenhouses to be built for the University of Saskatchewan. Tenders will be received until June 15th by Professor Greig.

Sault Ste. Marie, Ont.
George Carufel, Tancred Street, is considering the erection of a business block, estimated to cost $7,000. Work partly by sub-contract and day labor.

Simcoe, Ont.
A by-law has been passed authorizing the loan of $20,000 to the Unique Sales Company, who propose to build a branch factory. Architect not yet appointed. Secretary, J. W. Phillips, 10 West Market Street, Toronto.

St. Georges, Que.
Gedeon Gagne has commenced the erection of a store, estimated to cost $6,000. Brick and frame construction.

Toronto, Ont.
The Exhibition Board propose to construct two platforms in connection with the Eastern entrance of the Street Railway into the Grounds.

G. D. Redmond, Architect, 33 Fairview Boulevard, is preparing plans of a picture theatre, estimated to cost $25,000. Tenders will be called shortly. Artificial stone, brick and steel construction.

CONTRACTS AWARDED

Fort William, Ont.
The general contract for the erection of a bakery for J. Wismer, 132 Ogden Street, has been awarded to T. F. Jones, 435 Archibald Street. Frame and brick construction. Approximate cost, $3,000.

Guelph, Ont.
The general and carpentry contracts for the erection of a foundry for F. Callendar, Eramosa Road, have been awarded to J. W. Oakes, Kathleen Street, masonry to J. Checkley, roofing to McCormack Brothers, painting to Reynolds & Son, Quebec Street, and plumbing to F. Smith, Quebec Street. Estimated cost, $7,000.

Lindsay, Ont.
The general contract for the erection of a factory for Horn Brothers Woollen Company, Limited, has been awarded to H. T. Hickey, Peterboro. Approximate cost, $25,000.

Markham, Ont.
The Markham Agricultural Society have let the general contract for the erection of a hall and rink to James Miller, Unionville, Ont. Approximate cost, $8,500. Steel frame and galvanized iron construction.

Medicine Hat, Alta.
The contract for the erection of a flour mill for the Lake of the Woods Milling Company has been awarded to Carter-Halls-Aldinger & Company, 1010 Union Bank Building, Winnipeg. Approximate cost, $200,000.

Ottawa, Ont.
The following contracts have been let for the erection of a factory for Grant, Holden & Graham, 147 Albert Street:—general contract, Charles Holbrook & Son, 425 Somerset Street; steel, Dominion Bridge Company, Sparks Street, and A. G. Marshall, Booth Building; heating and plumbing, F. Livock, Albert Street; steel sash, G. B. Reynolds, 59 Beaver Hall Hill, Montreal.

S. W. Halliday, 20 Arlington Avenue, has let the contract for brick work in connection with the shop which he is building to J. McCathey, Arlington Avenue, and heating and plumbing to J. R. McLennan, 240 Bank Street.

The general contract for the erection of a bowling alley on Bank Street for a Syndicate has been let to Samuel May & Company, 102 Adelaide Street West, Toronto. Approximate cost, $30,000.

Outremont, Que.
The general contract for alterations to the premises of the British American Oil Company, 1090 Durocher Street, has been let to J. Hansen, 3169 Verville St. Brick construction. Approximate cost, $3,000.

Quebec, Que.
The general and masonry contracts for the conversion of premises into a bank for the Caisse d'Economie have been let to J. Chevalier, 44 Renaud Avenue. Approximate cost, $6,000.

Regina, Sask.
The general contract for the erection of a warehouse for the Canadian Consolidated Rubber Company, Limited, has been awarded to the Pool Construction

(Continued on page 49)

Tenders and For Sale Department

Tenders for Light Fixtures

Tenders for light fixtures for the new Registry Office will be received by registered post only, addressed to the undersigned, up to noon on **Tuesday, June 6th, 1916.** Plans and specifications may be seen and forms of tender, and all information obtained at the office of the City Architect, City Hall, Toronto. Envelopes containing tenders must be plainly marked on the outside as to contents. The usual conditions relating to tendering, as prescribed by the City By-laws, must be strictly complied with or tenders may not be entertained. Tenderers shall submit with their tender the names of two personal sureties, or the bond of a Guarantee Company approved by the City Treasurer. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman of Board of Control.

22-22

Department of Railways and Canals, Canada

Hudson Bay Railway Terminals

PORT NELSON, MAN.

Sealed tenders endorsed Tender for "Provisions" or tender for "Hardware Supplies," as the case may be, will be received by the undersigned up to 12 o'clock noon, on **Tuesday, the 6th of June, 1916**, for the furnishing of "Provisions," and on **Saturday, the 10th of June, 1916**, for the furnishing of "Hardware Supplies," to be delivered in such quantities at Halifax, N.S., and at such times as may be directed.

Dealers may tender for the total quantities required, or for such portions thereof, as may suit their convenience.

Specifications of requirements, and full information can be obtained from the Purchasing Agent of the Department of Railways and Canals, Ottawa, on and after this date.

An accepted bank cheque in the case of "Provisions" for $500, and in the case of "Hardware Supplies" for $500, made payable to the order of the Minister of Railways and Canals, must accompany each tender, which sums will be forfeited if the party tendering declines entering into contract for supplying any of the goods awarded to him, or in any way fails to properly fulfill the same.

The cheque thus sent in will be returned to the respective contractors whose tenders are not accepted.

The cheque of the successful tenderer will be held as security, or part security, for the due fulfilment of the contract to be entered into.

The lowest or any tender not necessarily accepted.

By order,

J. W. PUGSLEY,
Secretary.

Department of Railways and Canals.
Ottawa, May 22, 1916.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.—84408. 22-22

Tenders for Pavement

Tenders will be received by the undersigned up to **June 3rd, 1916**, for the construction of macadam pavement on Turnberry Street, Brussels. Plans and specification in the hands of the Clerk after May 24th, 1916.

21-22 F. S. SCOTT, Village Clerk.

Tenders for Paving

Sealed tenders addressed to John Morrison, City Clerk, Woodstock, Ont., will be received up to 4 p.m. of **Friday, the 9th day of June**, for the construction of about 12,000 sq. yds. of reinforced concrete pavement on Riddle Street. Alternative tenders will also be received for "Bitulithic," "Asphalt" and "Asphaltic Concrete," with concrete base and concrete curb and gutter. Plans and specifications may be seen at the Engineer's office, Woodstock. The lowest or any tender not necessarily accepted.

JAS. MITCHELL,
Chairman, Board of Works.

F. J. URE, City Engineer. 22-22

TENDERS

Sealed tenders will be received up to 6 p.m. of **Monday, June 12th, 1916**, by the Secretary, for the erection and completion of a six-room school building to be built in Parry Sound, Ont., for the Parry Sound Public School Board.

Plans and specifications may be seen at the office of the Secretary-Treasurer, Parry Sound, Ont.; the office of the Contract Record, 347 Adelaide Street West, Toronto, Ont., and at the office of the Architects, Angus & Angus, Angus Block, North Bay, Ont.

The successful contractor will be required to furnish a satisfactory guarantee.

The lowest or any tender not necessarily accepted.

J. D. BROUGHTON,
Sec.-Treas., Parry Sound Public School Board,
Parry Sound, Ont.

22-22

THE PAS, MAN.

Sealed tenders, registered and endorsed on the envelope, "Tender," and addressed to H. H. Elliott, M.D., Secretary-Treasurer of the Town of The Pas, Man., will be received up to 6 p.m., **June 22, 1916**, for the supply and delivery of the following machinery and materials:—

Tender "A"—For the supply and delivery of two Sewage Lift Pumps.

Tender "B"—For the construction of a Sewage Lift Chamber.

Marked cheque for five per cent. (5 p.c.) of the amount of the tender must accompany each bid. The lowest or any tender not necessarily accepted.

Plans and specifications may be seen at the office of the Consulting Engineers, Saskatoon, Sask.; the Resident Engineer, The Pas, Man.; Tender "A" only at Contract Record, Toronto, Winnipeg, and Montreal.

MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.

H. H. ELLIOTT, M.D.,
Secretary-Treasurer,
The Pas, Man.

22-24

Tenders for Bridge Abutments

Township of South Dumfries

Sealed tenders, clearly endorsed on the outside "Tenders for Abutments, Manwaring Creek Bridge," will be received by the Township of South Dumfries up till noon, **Monday, June 5th, 1916**.

The site of the bridge is about 1 mile east of the Village of St. George, on the side road between Lots 3 and 4, Concession 3.

The abutments contain 76 cubic yards of concrete and 6,390 lbs. of steel.

Plans and specifications may be seen at the office of Jackson & Lee, Township Engineers, Temple Building, Brantford, from whom tender forms may be obtained.

Tenders must be addressed to Henry Maus, Paris, Ont., Clerk of the Township of South Dumfries.

JACKSON & LEE,
Township Engineers.

22-22

STEAM ROLLERS FOR SALE

One single cylinder Sawyer Massey 13 tons; one double cylinder Waterous, 15 tons. Both in perfect condition. Apply to Box 196, Three Rivers, Que. 22-23

FOR SALE

One Cube Concrete Mixer, with Boom and Bucket Attachment. One Foote Continuous Concrete Mixer, No. 3. One Five-ton Horse Roller. Dump Wagons, Plows and numerous other contractors' tools. For particulars address C. H. Kaumeier, care P. O. Box 99, Welland, Ont. 22-23

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

Plant For Sale

1 Smith Concrete Mixer	$400
1 Wettlaufer Mixer with Engine	250
1 20-H.P. Upright Hoisting Engine ...	450
2 10-H.P. Motors, D.C. ... ... each	85
1 30-H.P. Motor, D.C.	150
1 "American" Hoisting Engine for Barrow Hoist	350

HOLMES, 1107 Yonge Street, Toronto. 22-25

POSITION WANTED

As Superintendent or Foreman, by capable man of large experience in the stone business in charge of quarrying, cutting or construction work. Best of references. Box 404, Contract Record, Toronto, Ont. 21-23

Business Buildings and Industrial Plants

(Continued from page 47)

Company, Limited. Saskatchewan Co-operative Building. Estimated cost, $24,000. Previous report in error.

St. Catharines, Ont.
The general and masonry contract for the erection of a factory for the McKinnon Dash & Hardware Company has been let to Newman Brothers, 71 St. Paul Street, carpentry to C. F. Monk, Wilson Street, and steel work to the Hamilton Bridge Company, 1 Bay St. North, Hamilton. Approximate cost, $10,000.

Toronto, Ont.
In connection with the fire hall now in course of erection on Hendrick Street, the contract for plumbing and heating have been let to J. Ritchie Plumbing & Heating Company, Limited, 56 Adelaide Street E., the wiring to the Toronto Electric Company, 101 Duke Street, roofing to George Sinclair, 307 Clinton Street, and painting to C. W. Landon, 569 College Street.

The general contract for an addition to the Christie Street Car Barns has been let by the Board of Control to R. Chalkley & Son, Limited, 34 Victoria Street, at $24,435. Brick and concrete construction.

The general contract for the erection of a warehouse for Henry Greisman, 68 Adelaide Street E., has been let to L. E. Dowling, 167 Yonge Street. Brick and mill construction. Approximate cost, $50,000. General contractor is now receiving prices on all trades.

Westmount, Que.
Robertson Brothers, 40 Chestnut St., are building a garage for D. J. Finlayson, 366 Victoria Avenue. Reinforced concrete and brick construction. Approximate cost, $3,000.

Residences

Brigden, Ont.
William Shaw, Concession 6, Moore Township, Brigden, is considering the erection of a residence, estimated to cost $3,000.

Charlottetown, P.E.I.
Chappelle & Hunter, Architects, DesBresay Block, are preparing plans of a residence for F. J. Holman, 162 St. George Street. Frame and concrete construction. Approximate cost, $3,500.

Dorchester, Ont.
M. Nugent is building a residence, estimated to cost $3,000. Red pressed brick construction.

Hamilton, Ont.
Charles Morrelli, 201 Sherman Avenue North, proposes to build two residences on Brant Street, and has had plans prepared. Brick and concrete construction. Approximate cost, $3,400.

Hensall, Ont.
A. Hemphill is considering the erection of a residence on London Road, at an approximate cost of $3,500.

London, Ont.
W. G. Murray, Architect, Dominion Savings Building, is preparing plans of two residences, estimated to cost $4,500 and $4,000 respectively. Red pressed brick construction.

Merlin, Ont.
A. Gosnell has commenced the erection of a residence, estimated to cost $4,000, and contemplates building another at an approximate cost of $3,000. Concrete block construction.

Montreal, Que.
M. A. Racine, Gouin Boulevard, has commenced the erection of a residence, estimated to cost $3,000. Brick construction.

J. B. Denteneer, 244 Sherbrooke Street E., is receiving tenders on roofing, heating, plumbing and electrical work required in connection with three flats which he proposes to build. Estimated cost, $6,000.

Neustadt, Ont.
Philip Binkle is preparing plans of a residence, estimated to cost $3,000. Owner will do all work.

Norwich, Ont.
G. D. Redmond, Architect, 33 Fairview Boulevard, Toronto, is receiving tenders on the plumbing and heating required in the erection of two residences for George West. Approximate cost, $4,500.

Ottawa, Ont.
W. C. Leech, 140 Spadina Avenue, contemplates the erection of two residences, at an approximate cost of $3,500 each. Brick veneer and stone construction.

Plans are being prepared by W. H. George, Castle Building, for a residence to be built for J. Moffat Ross, 49 Metcalfe Street. Brick veneer construction. Approximate cost, $7,000.

The erection of a residence is contemplated by McLeod McAllister, 20 Willard Street. Brick and stucco construction. Estimated cost, $3,500.

Outremont, Que.
P. Guidazio, 44 Marsolais Avenue, has commenced the erection of five residences on Davaar Street, estimated to cost $35,000. Brick and stone construction.

L. J. Bigonesse, Architect, 60 Notre Dame Street E., is receiving private tenders on the erection of two residences for A. Boyer, 1058 Berri Street. Estimated cost, $10,000.

Quebec, Que.
E. Bouchard, St. Gregoire Street, has commenced the erection of a residence, estimated to cost $4,000. Frame and brick construction.

Renfrew, Ont.
J. K. Rochester proposes to build a tenement on Raglan Street, at an approximate cost of $3,500. Stone and roughcast construction.

Riverside, N.B.
The tenders received for the erection of a residence for F. W. Roach, care of Brock & Patterson, King Street, St. John, are unsatisfactory, and the plans will be revised. Architect, Leonard Heans, 84 Germain Street, St. John. Approximate cost, $5,000.

Sault Ste. Marie, Ont.
Plans of a residence are now being prepared for Orval Johnston, care of the C. P. R. Telegraph. Estimated cost, $5,500.

Tavistock, Ont.
The Congregation of the Evangelical Church propose to build a Parsonage at an approximate cost of $4,500, and have purchased a site. Plans will be prepared as soon as possible. Pastor, Rev. A. D. Gischler.

Toronto, Ont.
F. W. Hill, 55 Wolfrey Avenue, proposes to build a duplex residence, at an approximate cost of $3,000, and has had plans prepared. Brick construction.

W. P. Levack, 519 Roxton Road, is considering the erection of three residences, at an approximate cost of $4,000 each. Smaller trades will be let. Brick construction.

L. Wilks, 20 Lincoln Avenue, has commenced the erection of a residence, estimated to cost $3,500. Brick construction. Smaller trades will be let.

Devine Brothers, 51 Bird Avenue, have started work on a residence on Lauder Avenue, estimated to cost $3,800. Smaller trades will be let. Granite concrete block and brick construction.

W. H. Moore, 79 Bellefair Avenue, is receiving tenders on labor only for carpentry, plastering, painting and brick work required in the erection of a residence and garage. Estimated cost, $3,000.

C. Parker, 609 Davenport Road, has started work on a residence, estimated to cost $7,500, and will let smaller trades. Brick construction.

W. P. Levock, 519 Roxton Road, has commenced the erection of a residence, estimated to cost $4,500. Smaller trades will be let. Brick construction.

G. D. Redmond, Architect, 33 Fairview Boulevard, is receiving tenders on the erection of a pair of residences on Lamb Avenue. Brick construction. Approximate cost, $4,000.

Warwick Township, Ont.
W. R. Thompson, Concession 2, Watford, proposes to build a residence to replace that recently destroyed by fire. Estimated cost, $3,000.

Westboro, Ont.
P. Sabourin, 17 Lowery Street, has commenced the erection of a residence, estimated to cost $3,000. Frame and concrete construction.

Wheatley, Ont.
Work on the erection of a residence has been started by J. P. Crowther. Frame and white brick construction. Approximate cost, $3,000.

CONTRACTS AWARDED

Aylmer, Ont.
The general contract for the erection of a residence and garage for A. W. Pierce has been let to C. M. Smith, Wellington Street. Estimated cost, $10,000. Brick, stone and concrete construction.

C. M. Smith has also been awarded the contract for the erection of a residence for John H. Strachan. Red pressed brick construction. Approximate cost, $3,500.

Cedar Beach, Ont.
W. T. Conklin, Kingsville, Ont., has been awarded a contract for the erection of three summer cottages for J. W. Richardson, C. M. Carson and W. Lang. Frame construction. Approximate cost, $6,500.

Hamilton, Ont.

S. S. Forbes, 165 Sanford Avenue S., has let the contract for plastering in connection with three residences which he will build to H. Hancox, 41 Robins Avenue, the plumbing to J. Hart, 1 Nightingale Street, and electrical work to J. Dynes, 161 Sanford Avenue S. Approximate total cost, $4,500.

The general, masonry, steel and roofing contracts for the erection of a residence for G. S. Dunkin, 71 Barnsdale Avenue S., have been awarded to Mitchell & Riddell, Head Street, and the carpentry to R. Huxtable, 70 St. Clair Street. Estimated cost, $5,000.

Williamson & Torrence, 469 King St. E., have let the following contracts for the erection of two residences:—general, masonry, carpentry and roofing, S. S. Forbes, 165 Sanford Avenue; plastering, H. Hancox, 41 Robins Avenue, plumbing, J. Hart, 1 Nightingale Street; electrical work, J. Dynes, 161 Sanford Avenue S. Estimated cost, $5,000.

The general, carpentry and roofing contracts for the erection of a residence for F. Wilson, 88 Melrose Avenue, have been awarded to J. Ireland, 161 Hess Street N., and the masonry to A. Beddie, 207 Burris Avenue. Approximate cost, $3,800.

Montreal, Que.

The general contract for the erection of a residence for C. Galibert & Son Company, 1123 St. Catherine Street, has been let to Martineau & Prenoveau, 643 Berri Street. Brick construction. Estimated cost, $4,000.

In connection with the residence now in course of erection for F. Bonnier, 1639 St. Catherine Street E., the contract for masonry, carpentry, plastering, painting and interior fittings has been let to the general contractor. Tenders are now being received for roofing, heating, plumbing and electrical work.

Ottawa, Ont.

The general contract for the erection of a residence for J. G. Jones has been let to Walter Fryer, 5 Glen Avenue. Brick veneer construction. Approximate cost, $4,600.

In connection with the residence in course of erection for C. Sutherland, 460 McLeod Street, the plastering contract has been awarded to Thomas Patterson, 70 Rosedale Avenue, and painting to Ritchie & Nunn, 163 Sunnyside Avenue.

Outremont, Que.

The Cooke Estate, 28 Dunlop Street, have let the following contracts for the erection of two cottages:—masonry and excavation, James Young, 540 Maplewood Avenue; carpentry, D. M. Long, Regd., 204 William Street; roofing, Richardson, Simard & Company, 745 Clarke Street; plastering, Watson & Wilson, 1678 Hutchison Street; painting, A. Craig Ltd., 41 Jurors Street; heating and plumbing, J. Colford, 456 Guy Street; electrical work, Vincent & Say Electric Company, 25 Union Avenue. Approximate cost, $10,000.

Quebec, Que.

The general contract for the erection of a residence for Raymond Bussiere, 2 Marie Louise Street, has been let to A. Vachon, 119 Marie Louise Street. Frame and brick construction. Approximate cost, $4,000.

The general, masonry, and carpentry contracts for the erection of a residence for F. Gingras, 36 St. Augustin Street, have been let to Jinchereau & Lamonde. Brick construction. Estimated cost, $8,000.

Sault Ste. Marie, Ont.

In connection with the erection of a residence for W. H. Ewing, Albert St., the painting contract has been let to William Hallam, and plastering to W. Wray.

Sherbrooke, Que.

The general contract for the erection of a residence for T. J. Parkes, 5 Portland Avenue, has been awarded to Loomis, Dakin Limited, St. Gabriel Street. Approximate cost, $7,000.

St. Audrews, N.B.

The general contract for the erection of a residence for Mrs. E. C. Walker has been let to Fussing & Jorgensen Brothers, 6 Durocher Street, Montreal. Stone, brick and roughcast construction. Approximate cost, $20,000.

Toronto, Ont.

Tomkins & Baskerville, 490 Oakwood Avenue, have the contracts for the erection of two residences in York Township, at an approximate cost of $3,000 each. Brick construction.

Plans have been prepared for the erection of two residences for Mrs. C. Blair, 948 Logan Avenue, and the contract for plumbing and heating let to D. A. Blair, 948 Logan Avenue. Brick construction. Approximate cost, $8,000.

Windsor, Ont.

In connection with the erection of a residence for W. E. Rigg, 35 Pitt Street E., the carpentry has been let to J. R. Sculland, Tuson Block, roofing to Canadian Roofing Manufacturing Company, McDougall Street, and painting to the Canadian Glass Company.

The following contracts have been awarded for the erection of flats for Louis Kaplan, Wyandotte Street E.:—masonry, Thompson Brothers, Chatham Street W.; carpentry, S. Burch; roofing and plastering, Welch Brothers; painting, William Laesser, 94 Jeanette Street; heating and plumbing, Windsor Hardware Company, 71 Sandwich Street E.; electrical work, Gilbert Campeau, 121 Tuscarora Street. Approximate cost, $15,000.

Power Plants, Electricity and Telephones

Orillia, Ont.

The by-law to provide for the transfer of the power plant to the Ontario Hydro Electric Commission has been defeated. The Town will now proceed with the plant at Swift Rapids, estimated to cost $90,000. Switchboards, water wheel, transformers and other equipment will be required for two units of 1,600 h.p. each. Engineer, W. K. Greenwood.

South Melfort, Sask.

Tenders on the construction of the proposed system of the South Melfort Rural Telephone Company will be received until June 14th by the Secretary, Walter Armstrong, South Melfort Post Office.

CONTRACTS AWARDED

Copper Mountain, B. C.

The British Columbia Copper Company, Copper Mountain, have awarded the contract for the construction of a transmission line from East Princeton to J. MacDonald, Princeton.

London, Ont.

The Hydro Commission have let the contract for the supply of Wire cables to the Northern Electric Company, 131 Simcoe Street, Toronto, and for supply of poles to W. McFadden, Heaslip, Ont.

Fires

Hamilton, Ont.

Residence owned by W. J. Southam. Loss, $10,000.

Montreal, Que.

Store of Louis Wisintainer & Son Company, 58 St. Lawrence Boulevard. Loss, $15,000. Will be rebuilt.

Store building, owned by N. G. Valiquette Ltd., 477 St. Catherine Street E. Loss, $4,000. Repairs will be made.

Wainwright, Alta.

Pump house owned by the Grand Trunk Pacific Railway, Winnipeg. Owners will rebuild.

Westboro, Ont.

Store owned by Frank O'Malley, Victoria Avenue. Loss, $6,000. Owner may rebuild.

Store owned by Patrick Mears, William Street. Loss, $4,500. Will be rebuilt.

Miscellaneous

Montreal, Que.

The Dominion Bridge Company, Lachine, have been asked by the City Council to prepare plans and specifications for headgates for the Lachine Canal. Estimated cost, $100,000.

Preston, Ont.

The Town Council will shortly submit a by-law to authorize the expenditure of $10,000 on a fire engine. All communications must be sent to Mayor Hurlbut, Hurlbut Shoe Factory, Pdeston.

Toronto, Ont.

W. J. McCormick, 2,000 Bloor Street West, is constructing a concrete swimming tank, estimated to cost $3,500.

Trail, B.C.

The Trail Poultry Association have appointed a Committee to consider the construction of a swimming pool and gymnasium, at an approximate cost of $8,000. Secretary, J. A. Wadsworth.

Cut Vent Holes and Fill Settles to Firm Foundation

At various points tbe Coleman-du Pont concrete road, in Delaware, was constructed over swamps. Ordinarily these were drained before the fill was deposited, but in one case the cost would have been prohibitive so the fill was made directly on the surface of the swamp, which floated on several feet of black muck. Below this was a solid foundation of sand and bog ore. It was thought that the weight of the embankment would carry it down to this stratum, but it did not. The difficulty was surmounted by cutting holes through the swamp surface near the toe of the fill. The muck was forced up through these and the solid earth settled down to the firm foundation.

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Vol. 30 June 7, 1916 **No. 23**

Principal Contents

Mechanical Filtration of Water

THE rapid development in the science of bacteriology and the resultant study of water-borne diseases, have in the last few years focused public attention on polluted water supplies and created a demand for pure water. The question of the best methods to employ for the filtration and purification of water cannot be settled by mere dogmatic assertions. It is no more true that any one treatment is the best to employ for dealing with all classes and conditions of water than it is to say that any one type of sewage disposal is applicable to any and every case.

Open sand filters or slow sand filters for purifying water have been in operation for nearly a century, while mechanical filtration or rapid sand filtration first made its appearance about thirty years ago. The arrangement of the filtering material differs little in sections between the rapid and slow processes, but the water under treatment in the mechanical filter is passed through the materials at a speed from twenty to sixty times greater than that which has been found in practice to represent a safe limit of speed in slow sand filtration in order to obtain complete purification of the water.

* * *

The slow sand filtration involves large areas of artificial sand beds which are quite expensive in construction and are sometimes beyond the means of many small communities. There is no doubt whatever, however, that from its inception slow sand filtration has given remarkably good results in purifying polluted water. However, as the efficiency of the slow sand process increases its ability to allow for the passage of water through it decreases. Good results have also been obtained from the mechanical filter, but it is necessary in this process to employ coagulants and generally, though not always, to have pumping machinery to operate the apparatus. The efficiency of the open sand filtration is believed to be exceeded by no other process for removing bacteria and other organic matter, although mechanical filters with a coagulant have given an efficiency only one or two per cent. less. But the possibility of serious lapses in full efficiency is greater with the mechanical than with the open filter.

The general practice in America has been to employ the mechanical or rapid process because of the facility with which clarification can be obtained and the comparative expense and difficulty with which the same result can be obtained by the slow process. Then, too, it has been discovered that mechanical filtration, in addition to being cheaper in first cost and operating cost than slow sand filtration, is better adapted to a wide range of conditions, and with water containing a large amount of fine suspended matter, could be used with success where the slow sand filter would be doomed to complete failure.

* * *

The mechanical system essentially consists of tanks containing sand through which water is passed at a high rate of filtration after it has been treated with a coagulating chemical. This chemical is added to the raw water before reaching the filter and forms immediately an artificial, gelatinous film over the surface of the sand, thereby collecting most of the foreign material on the surface and preventing clogging of the filter. These filters are cleaned at frequent intervals by reversing the current of water through them and washing the suspended matter out through a waste way near the top. While the experimental work of trained specialists in the last decade has placed the mechanical method of filtration on a sound basis, yet its success must be attributed to a greater extent to the development in the design of these filters and to the scientific methods of operation. Elsewhere in this issue is a paper by Thomas Fleming, Jr., on "The Improvement in the Art of Mechanical Filtration," which enumerates in a very detailed manner the developments which have been made. Previous to 1900, mechanical filters were built of wood or steel; modern practice, however, is to build them almost entirely of concrete and equip them as far as possible with automatic control devices for the operation of their different functions. The mechanical filter is almost universal in Canada and the United States; to-day there are approximately twenty million people supplied with filtered water, and of this amount, practically fourteen million, or two-thirds, are supplied with filtered water from some 600 mechanical filtration plants.

Prepare for Mosquito Extermination

THE season is upon us when the extermination of mosquitoes is one of our ever-present problems. Canadian municipalities, however, do not appear to have made much effort to exterminate these pests. In later years their invasion of our larger cities, which formerly were more or less immune, indicates an increase in both number and activity and it is increasingly evident that in defense of the good health of our citizens, to say nothing of our personal comfort, some systematic move must soon be made by our civic authorities to prevent the further increase of these troublesome insects and, if possible, remove the cause of their being.

The city of Philadelphia is an example of what some of the larger cities on this continent have been attempting during the past few years. Since 1912 some 65 miles of ditches have been reconstructed with the idea of improving the drainage; approximately 12,000,000 square feet of pools have been oiled or sprayed; 27,000 sewer inlets oil treated and 300,000 square yards of weeds cut down. The following details of this work are taken from the advance report of the New York State Conference of mayors and other city officials prepared by Mr. W. H. Connell.

Experience in Mosquito Extermination

The mosquito extermination campaign in Philadelphia started in July, 1912, with an appropriation of $5,000 for experimental and actual work. The poor drainage system over 8,000 acres of lowland in the southern section of the city caused through obstructed ditches, which had not been properly maintained for several years previous to that time, had practically converted this area into swamp land where millions of mosquitoes bred annually. During the past year 30 different varieties of mosquitoes were identified and large numbers of malaria-bearing mosquitoes were found in all sections of the city.

Preparatory to starting the actual work of mosquito extermination in 1913 the early part of the year was devoted to an educational campaign in which many lectures were given and over 100,000 pamphlets bearing on the life history of mosquitoes and practical methods of extermination were distributed throughout the city to solicit the interest of the public. The appropriation of $5,000, however, did not permit of a decisive fight against the insects in the city limits simultaneously, and the work was confined principally to sections where they bred habitually and to relieve local complaints. During this year the salt-marsh species, a larger and more active mosquito than the house-breeding variety, made its appearance in the lower part of the city in large numbers and much time and attention were given to extermination work against this particular pest in its original breeding places.

The force of men varied from two to eight during the season of 1914, and, while the appropriation was curtailed, a great deal of very satisfactory work was accomplished in oiling pools throughout the summer and latterly in oiling sewer inlets, which was tried out for the first time in the fall and continued until the middle of December. As a result, mosquitoes which ordinarily hibernate in sewer inlets over the winter were practically prevented from breeding and no complaints of the mosquito nuisance were received until four weeks after the first heavy rains in May, 1914.

The work of mosquito extermination in 1915 began on June 1, with an appropriation of $2,500, and extended to November 15. Probably no season since 1912 proved so very favorable for breeding purposes, as rain occurred at short intervals and formed thousands of pools. Breeding places on roofs and in tin cans on dumps and private property added to the multitude of complaints of mosquito annoyances. At one period of the summer the situation became so bad in many built-up sections of the city, bordering on large unimproved areas where weeds were permitted to grow to a height of 6 or 7 feet, that the city was forced to put an additional force of 200 men at work cutting down areas of weeds infested by mosquitoes. Table I. gives data on the work in 1915.

The actual appropriations for mosquito extermination during the past four years amounts to $13,900, and this amount, of course, is not sufficient to handle such a proposition, so important to the health and comfort of a community of the size of this city. With the limited appropriations, however, much progress has been made, and since 1912 over 65 miles of ditches have been reconstructed, which will permit of the proper drainage of an immense area which has heretofore afforded ideal breeding places for these pests. Approximately 12,000,000 square feet of pools have been oiled and sprayed, 27,000 sewer inlets oil treated and 300,000 square yards of weeds cut down in the effort to improve living conditions during the mosquito season. With a proper amount of money an entirely different plan than heretofore used for mosquito work could be put into effect, which it is confidently predicted would free the city from the mosquito nuisance.

Table I.—Work Done by Philadelphia City Forces on Mosquito Extermination, 1915

	No. of Jobs	Cost of Labor	Cost of Material	Total Cost
Oiling pools	2,600	$ 280.00	$ 49.50	$ 329.50
Oiling sewer inlets .	22,500	1,725.00	142.00	1,867.00
Filling in depressions, ditches, etc.	250	1,145.00	150.00	1,304.00
Totals	25,350	$3,159.00	$341.50	$3,500.50

The Metric System

Thoughtful business men are giving consideration to the advisability of Canada adopting the metric system of weights and measures when the war is over. It is pointed out by the advocates of the metric system that not only is it employed by such countries as Germany and Austria, who must for many years be the natural competitors of Canada in foreign markets, but that it is also used by friendly European countries, with whom there is a possibility of reciprocal trade arrangements being formed. It is stated that even now German and Austrian factories are piling up stocks of materials manufactured on metric terms of weight and measurement, and that these will be thrust on outside markets just as soon as peace has been declared. To meet this competition successfully and avoid confusion, a uniform system of weights and measures would seem to be a necessity.

Advances in Mechanical Filtration

Improvements in the Art of Rapid Sand Filtration in Constructional Design and Automatic Control Devices

By Thos. Fleming, Jr.*

MECHANICAL filtration or rapid sand filtration, as it is sometimes called, is an American invention, and first made its appearance in 1884. Previous to this, the European method of slow sand filtration had been introduced in this country at several places and was accepted generally as the only method of properly filtering a public water supply on a large scale. This method involved large areas of artificial sand beds which were quite expensive in construction and were beyond the means of many of the small communities and paper mills which were beginning at this time to demand filtered water supplies for contaminated and muddy water. The mechanical system, as proposed, consisted of small tubs or tanks usually containing a three-foot bed of sand through which the water was passed at a high rate of filtration after it had been treated with a coagulating chemical. This chemical was added to the raw water before reaching the filter and formed immediately an artificial gelatinous film over the surface of the sand, thereby collecting most of the foreign material on the surface and preventing a clogging of the filter. These filters were cleaned at frequent periods by reversing the current of water through the manifold in the bottom of the filter and washing the collected suspended matter out of a waste-way near the top.

During the next ten years after the appearance of this type of filter, quite a few of these plants were installed mostly for paper mills and small towns. The results obtained appeared to be more those of clarification than purification and there does not appear to have been much study in scientific operation. It was mainly a commercial proposition floated by private companies under the Hyatt patents with no expert supervision as to the operation or results obtained, and the result was that many of the plants proved unsatisfactory and this type of filtration was regarded as a cheap makeshift method to be used only when the cost of the slow sand system rendered it prohibitive.

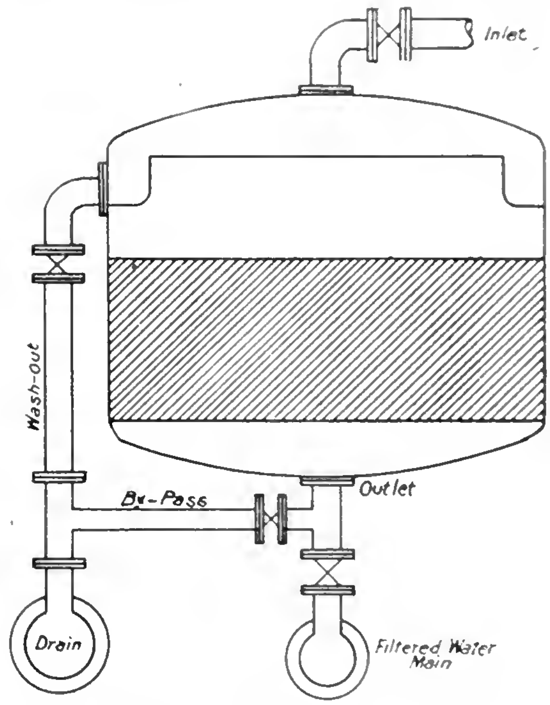
The facility with which clarification could be obtained by this method and the comparative expense and difficulty of accomplishing the same result by any other method, led, however, to the installation of this type of filter plant in quite a few important towns. These plants were built without settling basins along the lines of the first installations and it was soon found that they could not handle the water in these localities during periods of high turbidity. These plants were owned by private corporations, who made efficiency their highest aim in operation and experiments were immediately started in settling the water so as to reduce the load on the filters. It was found that coagulated water could be effectively settled in comparatively short periods of time, thereby greatly reducing the load on the filters during periods of high turbidity, and adequate settling basins were soon added to all of these plants, making them pioneers among the successful mechanical filter plants.

In Folwell's well-known book on "Water Supply," issued in 1900, we find the following statements concerning filtration:

"The efficiency of English sand filtration is thought to be exceeded by that of no other system. . . . . For removing bacteria and other organic matter, English filters give the best results; although mechanical filters with coagulation have given an efficiency only one-half to two per cent. less. But the possibility of occasional serious lapses in full efficiency is greater with mechanical than with English filters."

Several of the other authorities took this same attitude, and generally speaking, slow sand filtration was looked on as the only highly efficient method of filtration at this time. This is not strange considering the conditions under which mechanical filters had been developed, and also the fact that slow sand filters had been in successful use in England and on the continent for some time.

It is an interesting fact that in 1900, less than two million people in America were supplied with filtered water, while to-day we have approximately twenty million people supplied, and of this number, fourteen million, or two-thirds of the people supplied by filtered water obtained it from mechanical filters. The increase in the ratio supplied by this system has been most rapid in the last ten years. In 1900, there were less than one and a half million people supplied by this method; in 1910, this was increased to seven million, while in the last five years, the increase has been one hundred per cent. and there are now over six hundred mechanical filter plants in the United States and Canada.



General Arrangement of a Mechanical or Rapid Filter.

While the experimental work of trained specialists in the last decade has placed this method on a sound basis, yet its success must be attributed to a great ex-

* Before the Engineers' Society of Western Pennsylvania.

tent to the development in the design of these filters and to the scientific control of operation. Municipalities were loath to consider filter plants of this type as long as they were controlled by a basic patent, but when the Hyatt patents expired in 1901, it opened up the field of competition and it was possible to prepare a design on which competition could be secured. Then, too, it was discovered that mechanical filtration, in addition to being cheaper in first cost and operating cost than slow sand filtration, was better adapted to a wide range of conditions, and with water containing a large amount of fine suspended matter could be used with success where the slow sand filter would be doomed to complete failure.

It is not the intention to convey the impression that mechanical filters will entirely supersede slow sand filters, for there are certain conditions where the latter are undoubtedly better suited, but for the surface supplies of the main portion of our country which are subject to wide fluctuations in turbidity, the modern mechanical filter plant will give the highest efficiency and at the lowest cost, not only in first cost, but also in operation.

The large number of filter installations in the last fifteen years which, as we have just pointed out, has increased the number of consumers of filtered water from two million to twenty million, cannot be attributed so much to the improvements in the art of filtration as to the necessity for pure water supplies and the awakening of public interest in such matters. The rapid development in the science of bacteriology and the resultant studies of waterborne diseases have in the last few years focused public attention on polluted water supplies and created a demand for pure water.

The most important improvements in mechanical filters which distinguish the modern plant from the type of plant constructed fifteen years ago, may be classified under the following headings:

Permanent type of construction.

Adequate settling and coagulating faculties.

An accurate and adjustable filter control.

Accessibility and uniform distribution of collecting systems.

A self-cleansing wash system.

Reliable control of chemical feed.

Hydraulic operating valves, and recording devices.

Expert supervision.

Under these general headings, it is proposed to discuss the various improvements.

Permanent Type of Construction

Previous to 1900, mechanical filters were built of wood or steel. If of the gravity type, they consisted of circular tubs of various designs, some containing the filter only and some consisting of double deck structures 16 feet high, the upper 8 feet holding the filter and the lower 8 feet being utilized as a small coagulating basin. Many of the plants consisted of pressure filters looking very much like steel boilers in which the filter was constructed and operated under pressure. Usually the filters were installed on the supply main from the pumps to the distributing system. As a result of the experimental work previously outlined, it was clearly demonstrated that it was impossible to operate pressure filters on contaminated waters with any guarantee of a uniformly high efficiency. It was found, after a certain loss of head is developed by the friction in passing through the filter, that there is a tendency for the surface film over the sand to break, and as this film is mainly responsible for the retention of the bacteria, the filter under such conditions would become merely a strainer retaining the suspended material but permitting the bacteria to enter the filtered water. Further, it was found impossible to get the operators to make the necessary daily inspections of the filters to determine the condition in which they were and to properly govern the washing and cleaning. The result was that the pressure type of filter was discarded as unsuitable for this purpose. The steel and wooden tanks had a comparatively short life, and with the adoption of reinforced concrete for construction work, it was natural that designers in filtration work should turn to this type of construction for the filter tubs. This permitted the construction of rectangular filters in larger sizes and of a shape more adapted to economizing on space.

To-day, the reinforced concrete type of filter can be constructed more cheaply than steel tubs, as has been demonstrated on bids taken both ways on several recent installations. Wooden tubs can, of course, be constructed more cheaply and are still used in temporary installations or in extreme cases where first cost is vital. Practically all of the plants which have been constructed in the last ten years have been of the reinforced concrete type.

There has also been a great change in the quality of the equipment. Flanged cast iron pipe is now used inside of all structures on pressure lines. Reinforced concrete floors have displaced the old wooden operating platforms and the clear wells are now covered with the same type of construction and sealed to avoid contamination. Many of the older plants can still be found, however, where the clear well below the filters is covered by loose boards which form a hazardous protection. Fire-proof buildings for housing the filters, coagulant apparatus and equipment are now the universal standard, where formerly frame structures were not infrequent. In the more recent plants attention has been given to the architecture and to obtain a pleasing and neat appearance in the surroundings.

What has been said concerning the filters also applies to the settling basins. The wooden and steel tanks formerly so common have given place to reinforced concrete basins, carefully designed.

Adequate Settling and Coagulating Facilities

The originators of the mechanical filters paid very little attention to preliminary settling. Most of the early plants installed provided at the most a half hour period of settling and this appears to have been given mainly to secure a thorough coagulation of the water before it reaches the filter. The filter was supposed to do all the work, and it is surprising that the system was as successful as records show.

There are many plants in operation to-day where the settling basins do 90 per cent. of the work during periods of high turbidity, and it is found that in addition to taking out the suspended matter, about the same per cent. of bacteria is removed, presumably by being taken down with the settlement of the coagulated suspended matter.

The average filtration plant to-day is provided with a period of at least four hours of settling with coagulants, and unless there is considerable coarse suspended matter in the raw water at times, no preliminary natural settling is provided. The settling basins are designed in duplicate so that one basin can be cleaned during a favorable condition of the water without closing down the plant. The modern settling basin is constructed of reinforced concrete and the bottoms are sloped with a sufficient grade to permit of the natural flow of the solid matter to a central drain which is controlled by a valve from the top of the basin. A pressure line with hose connections is provided for flushing down the sides and bottom. In the northern latitudes, the basins are covered with reinforced concrete to prevent trouble from freezing during the winter period.

A coagulant is usually fed into the raw water at a special mixing compartment before entering the basins. This compartment is also constructed of concrete and equipped with adjustable wooden baffles which can be set close together in rows and adjusted so as to secure a thorough mixing of the water and chemical before it enters the basins. The entering water must be distributed uniformly across the inlet end of the basin and the basins must be sufficiently baffled to prevent any cross currents. Where two or more basins are constructed, they are often arranged to operate in parallel or series.

A Self-Cleansing System

Many filtration plants have suffered from an operating point of view due to a lack in proper facilities for thoroughly washing the filters. In the old types of filters, very little attention was paid to trough spacing and to the carrying height of water, but most of these filters were provided with mechanical rakes which thoroughly stirred up the sand during the washing period. When the modern concrete type of filter began to be adopted, agitation of the sand by compressed air was substituted for the old type of rakes and more attention was given to providing an adequate amount of wash water. This was limited usually to 8 gallons per square foot per minute, as it was found that a greater amount would disturb the gravel underlying the sand which was usually a small sized gravel ungraded and placed to a depth of eight or ten inches. Under these conditions and with the size of filter sand usually used, the trough system was placed at a height of 15 inches, which was found sufficiently high to prevent the overflow of sand. More recent experiments have shown that a more effective wash can be obtained by eliminating the mechanical agitation and cleaning the filter with a rate of wash of 15 gallons per square foot per minute, which is almost twice the rate formerly adopted. When a filter is washed at this rate, it is found that the entire sand bed is floated, the finer sand being lifted from 24 inches to 30 inches above the normal surface of the sand, and the wash troughs must therefore be constructed at this height. This system was first installed in the Cincinnati, Ohio, plant and gave great success, not only in thoroughly cleansing the filter, but in a lower operating cost and with a less amount of wash water. The trouble from the disturbing of the gravel was eliminated at Cincinnati by tying down the gravel to the bottom of the filter with a bronze screen. Recently it has been discovered that by grading the gravel and using a depth of from 15 inches to 24 inches and by controlling the flow of wash water so as to slowly and uniformly start and stop the wash that it is unnecessary to tie down the gravel in the filters, and several of the latest installations have been installed on this basis.

In connection with the washing of filters, apparatus for removing and replacing the sand by water carriage is of considerable value. Theoretically it should be unnecessary to remove or replace sand in a well operated filter for several years, but in the practical operation it has been found necessary to remove the sand much more frequently, due to displacement of gravel by carelessness of operator in applying the wash water, stopping up of the strainer system with sand, or stopping up of the manifold system or for various other reasons. While the cost of removing sand by hand from a mechanical filter is very small when compared with slow sand filters, yet a considerable saving in operating cost can be effected by installing a water carriage system. This requires a portable hand ejector, a small pressure line and a sand line, both located in the pipe gallery and arranged with outlets opposite each filter. The ejector is placed in the filter when sand is to be removed and connected by hose to the pressure and sand lines in the pipe gallery. The sand can then be removed to a storage bin or to another filter as may be desired.

Reliable Control of Chemical Feed

Many of the older types of filter plants made no provision for an accurate arrangement for feeding the coagulant solution. The material was dissolved in tanks many of which were entirely inadequate in size to enable the operator to use a dilute solution, and the method of operation consisted in dissolving so many pounds of coagulant and feeding this solution into the raw water in a certain period of time, depending upon the turbidity of the water to be treated. The outlet valve was opened a certain number of turns to give this desired rate, and a uniform feed by this approximate method was used.

The filter designers in the last few years have entirely revised this system of applying the coagulants, and most of the modern filter plants of any size have not only an adjustable feed for the chemical solution, but also an automatic arrangement for supplying this feed in direct proportion to the quantity of raw water being admitted to the plant, and further, electric alarms are being installed to immediately sound a gong in case of a stoppage in the flow of the chemical solution. Many of these arrangements are based upon a control from a Venturi meter on the raw water line, while an adjustable orifice enables the operator to set the desired rate of flow of the solution. The electric alarm is usually installed at the orifice and is of simple construction consisting of dry batteries and an open circuit which is closed at the orifice when the liquid fails to flow. The modern solution tanks are usually constructed of reinforced concrete and of ample size to provide sufficient storage for the solution under maximum conditions. They are provided with stirring devices driven by motors located on the operating floor above the tanks.

Hydraulic Operating Valves and Recording Devices

Most of the larger filter plants of recent construction have been equipped with hydraulically operated gate valves controlled from an operating table located in front of each filter. By means of levers on these tables, a valve can be opened or closed very quickly without the labor required on hand operated valves. This method of control is not only justified from an operating point of view in the reduction of operating expense, but also is valuable as affording a quick arrangement for manipulating the plant. The increased cost of equipping a filter with this apparatus is approximately $400 per filter, and the tendency to-day is to apply this equipment to even the smaller installations. The use of recording devices in the larger plants is essential and in the average plant can be judiciously used to advantage. It is inadvisable to overload a plant with recording apparatus on account of the increased cost from an operating point of view in adjusting and keeping up the records.

Building Conditions in Winnipeg

The Metropolis of the Middle West—Housing and Town Planning Associations — Limit Height of Buildings

By Arthur A. Stoughton, R.A.I.C.*

WINNIPEG has passed so rapidly from the frontier village stage, with all that that term connotes of shacks and mud and primitive society, to the dignity of a well-ordered city, with large and handsome buildings; having become a large producing and distributing centre, with an extensive banking system and all the features of the political society, that it is necessary to check up its status and achievements at frequent intervals in order to keep informed of its progress.

This is specially necessary for contractors and material men and manufacturers, both in the city and those at a distance, whose products are used there, lest its demands and the amount of commodities it can absorb and the opportunities it presents be underestimated. When we are faced with the fact that the year before the war, 1913, saw $12,000,000 worth of buildings erected there, which was one-quarter of the cost of new buildings for that year in New York city, we have to admit that Winnipeg is no mean city for the contractor. The Industrial Bureau, under its able head, Mr. Chas. H. Webster, acts as a clearing house for information and statistics, which I need not reproduce here, and a stimulus for the increase of manufactures and business in general, and, therefore, is an important aid to the activity of the contractor. The growth of Winnipeg in population and wealth is one of the most remarkable chapters in the history of civic development on the continent.

Present Conditions

As elsewhere, present conditions have put a quietus on most of this activity, but with the return of a normal state there will surely come a great expansion of business. Immigration of a good class will result from the devastation of the war and thousands of those whose homes and villages have been destroyed and others who prefer our peaceful prairies to the uncertainty of life in parts of Europe will settle here and around us. More acres will be tilled; more individuals will buy necessities and luxuries; more things will be produced; more money will circulate, and therefore more building will be done. The manufacturing of war material now and the feeding of Europe now and later will aid the general prosperous movement.

Even during this year many new industries have been started here and industrial plants erected. What may not be expected in increase in business as soon as the war is over? All should look to the future and consider plans for the handling of a larger volume of building work.

Winnipeg has already a good equipment of factories for the production of many of the building materials, iron, steel, woodworking, etc., and there are natural resources in the province of various building stones and timber and materials for good bricks and cement. The Tyndall limestone with a fossiliferous mottling is an excellent wearing and appearing limestone, used on very many of the best buildings. A fine dolomite has been recently found and is about to be put on the market. The "Made-in-Winnipeg" slogan has helped to create more home products, such plants being made possible by the increasing size of the city and its requirements, while very many eastern and foreign concerns have agencies here, some with their own local shops, at least for assembling.

It is an assured fact that Winnipeg will always be the metropolis of this whole middle country, acting as distributor and banker and clearing house and the transportation centre and labor market, and to a great extent, manufacturer, so that industries and business of every kind will concentrate here, as railways have already done. This means the greatest population and all those material needs which accompany size, growth, and activity. For the contractor it spells building of every kind—commercial houses, vast plants, school and public buildings, modest and expensive houses, bridges, railways and engineering structures of every kind.

Co-operation

The contractor should co-operate with the architect as a helper in this great building enterprise. As soon as society passes the primitive stage man seeks to order his building with a view to its agreeable appearance, which gives scope for the architect as distinguished from the mere builder or constructor. Anyone passing along the streets of Winnipeg will notice that the architects responsible for their appearance are men of taste who love their art. The architects of Winnipeg are a well-organized body who have secured the enactment of a good law which requires a high standard of training and experience in those who are admitted to practice. The architects meet informally at a weekly luncheon, which is addressed by some professional man on a subject more or less related to architecture. There are examples of the work of Eastern Canadian and American architects in the Fort Garry Hotel, the Union Station, the Bank of Montreal, and other fine buildings. It is well to have such buildings for variety and inspiration, but many buildings by local men are not a whit inferior to these. Not content with the recruiting of the profession from architects' offices or distant schools, they have succeeded in inducing the University of Manitoba to undertake this professional training. Two years ago a Department of Architecture was organized and a four years' course, similar in scope to those in Canadian and American universities, was inaugurated, in which construction and design are given equal weight, and the work is now proceeding favorably.

The University of Manitoba has grown so that it is crowded in its present buildings and is looking forward to occupying a fine new site for which an extensive group of buildings has already been projected. In connection with the Department of Architecture, an evening class for draughtsmen has been carried on with excellent results, so that, for a nominal fee, men engaged by day in offices can become designers and learn better rendering of drawings by working in this evening class. The new Art School of the Industrial Bureau provides good instruction in drawing and painting. The work of the Art Club, the Western Art Association, the Archaelogical Institute and the exhibi-

* Professor of Architecture in the University of Manitoba.

tions of paintings in the Art Gallery are all influential in raising the standard of art and culture which contributes to better building.

A great deal of construction has been going on, started before the war, such as the great Parliament Buildings, the Law Courts, the extensive group of the Agricultural College at St. Vital, each costing several million dollars, the Children's Home, the Fort Garry Hotel, and the enlargement of the Royal Alexandra Hotel, the Bank of Quebec, the Coco-Cola building and a large number of smaller business buildings and residences. The Ford Motor Company has just finished a large building as an assembling plant, in the west part of the city, on Portage Avenue. The Bank of Montreal is starting a very fine and handsome building, on Main Street, adjoining the Canadian Bank of Commerce. The Grain Exchange is adding several stories to its building. A group plan for the University was prepared and drawings for the first building, for engineering and architecture, made, which awaits more settled conditions for its development. Along Portage Avenue business buildings, large and small, have been erected, and all over the city houses and apartment blocks have sprung up in every direction.

Huge Department Store Buildings

The most important event in the building line, however, is the commencement of huge buildings by the T. Eaton Company to house their store and mail order business and to be their main distributing house for their Western Canada trade. They will cover two entire blocks between Portage and St. Marys Avenues and Hargrave and Donald Streets, having twelve high storeys, rising to a height of 215 feet, connected at every storey above the second by two bridge structures, spanning Graham Avenue, and under the whole of that street. It will be built in units of one-quarter of a block, eight storeys high, one each year for the next eight years, each costing approximately $600,000. When both blocks are thus covered to a height of eight storeys, the upper four storeys will presumably be built in the same way. The south building will be first constructed. The first unit, at the southeast corner of Hargrave Street and Graham Avenue, is now well along. The present store will be replaced only after the south building has been carried up the eight storeys. This great enterprise, undertaken in times when every person is inclined to delay expenditure, shows the confidence in the future of this city and the western country on the part of very sagacious and far-seeing men. It will inevitably be a powerful incentive to others to build, and it will tend to raise the whole tone of business and increase optimism.

Limit Height of Buildings

About a year ago the city passed a by-law limiting the height of buildings, which would have a far-reaching effect in preventing concentration of high buildings and real estate values in a few spots, to the detriment and impoverishment of other districts and in tending to keep down values to a reasonable figure and in equalizing and spreading business and traffic. It prescribes that buildings shall not be more than one and three-quarter times the width of the street in height and not more than 198 feet nor more than twelve storeys in height on any street. Nearly all Winnipeg streets are 66 feet wide so that on them buildings would not be more than 115½ feet high. Main Street, Portage Avenue, and Broadway are each 132 feet wide. On these, a building may not be more than 198 feet high, or one and one-half times the width of the street, but as it may not have more than twelve storeys, all ordinary buildings would be about 165 feet high, which is the height of the McArthur Building, on Portage Avenue, near Main Street, the highest, at present, except the Fort Garry Hotel, whose steep sloping roofs are 200 feet high. Any buildings on these side streets, needing very high storeys, could have twelve of them within 198 feet.

When the T. Eaton Company presented its proposal, as outlined above, to two buildings of equal height, the one on Portage Avenue being slightly higher than the limit for 132 foot streets, the one on the south block being one hundred feet higher than the limit for 66-foot streets, on four of which it faces, the City Council suspended the by-law to give special permission, and another exception was made a few weeks later to enable the Grain Exchange to add several storeys to its buildings, as originally planned. In view of these facts it seems highly improbable that this very desirable height limitation will be adhered to.

Winnipeg is most fortunate in the openness of its street system. Few cities in Canada have such an asset in wide main streets for business, and beautiful river scenery for residential districts, as well as the fine appearance of a great number of the residential streets. These are 66 feet wide with a 24-foot roadway, the remaining space being devoted to wide boulevards, well planted with grass and shaded by trees and maintained with assiduous care by the Parks Boards. There are a number of exceptionally fine residence districts, while the districts where the working people live are equally open and free from slums of the ordinary type.

House and Town Planning

The city seeks to improve its plan and provide for proper development in the future as well as co-ordination of its street system with that of the surrounding municipalities. It has had for some time a Housing and Town Planning Association and it now has a Committee of the Industrial Bureau of Town Planning and Civic Betterment to further schemes for improvement in various civic lines. It has appointed a permanent body known as the Greater Winnipeg Plan Commission to take in charge officially the work of planning and re-planning. This Commission is now preparing a comprehensive plan of the whole district, for the city to work to as the time goes on, and it is considering suggestions for individual changes, modifications or additions to the present plan where it is defective and where needed by new conditions of increased business, traffic, etc., to improve circulation, reduce friction, and further economy of transit. It will cultivate co-operation with city and environs as to through avenues; it will lay out a general park system and will provide for small parks and recreation spaces through the settled areas. Its task is a mighty one, as the city is so large—the area of Greater Winnipeg being 200 square miles—and there has been subdivision so far beyond settlement, but with the cordial support of the officials and the people, it hopes to make Winnipeg the finest city of the future in Western Canada, as it will be the largest and most important. Mr Thomas Adams, the Town Planning Advisor of the Commission of Conservation, visited it recently and made suggestions, but he said that it was already well provided with fine broad avenues for its main arteries.

A provincial town planning act was passed at the last session of the Legislature which gives to cities, town and municipalities greatly enlarged powers in the use of land in town planning schemes and for public purposes generally, and furnishes the procedure by which they may initiate plans and execute improvements. Already some are preparing to take advantage of these powers.

The Commission has, at the city's direction, provided the architectural treatment for several bridges, drawings for which were made by Mr. Paul Schioler, then City Bridge Engineer, which, if constructed, will be a series unique in Canada, in that engineer and architect have collaborated in designing bridges suitable in structure and agreeable in appearance. They will have no unsightly trusses and plate girders and bascule counterweights even are kept below the roadway, so that the piers and pylons, balustrades and lamps are treated entirely with regard to their aesthetic effect.

The economic problem bears heavily here as elsewhere, the army of the unemployed having mobilized here more numerously because Winnipeg is a larger city and because its extensive relief work is so well advertised. Many have suggested that its wisest relief work would be the undertaking of public construction; that it should pay wages instead of charity, and in so-doing it would add very little to the tax rate. The city is economizing to the last degree, reducing public expenditures, cutting down staff and avoiding all outlay in improvements which can be deferred. Perhaps this is penny wise and pound foolish. For improvements which will benefit the city of the present and future, debentures could be issued, with due regard to the life of the improvements. Future generations in their more prosperous times, would help to pay for what we should construct in these troublous times. Thus would present times be improved by the property created by construction and the circulation of money; unemployment would be relieved; advantage would be taken of low prices, and the burden to the present generation would be negligible in amount.

Waterworks and Sewerage Systems

of Canada, Statistically Reviewed in Recent Government Report—Some Typical Illustrations

THE Commission of Conservation of Canada have just issued a new edition of their book, "Waterworks and Sewerage Systems." A previous edition was prepared in 1912, in which it was aimed at presenting in a form readily available for reference, the principal physical data respecting the waterworks systems then in existence in Canada. The present report brings the waterworks systems up to date, and in addition, summarizes the sewerage systems.

The importance of sewage disposal can be readily appreciated when we consider the number of inland bodies of water which receive raw sewage and at the same time are the only available source of water supply for certain municipalities in the neighborhood. The supply of water to these communities is the most important use of these lakes and rivers and the value of a pure supply as compared with one polluted by sewage can scarcely be overestimated. Even where water systems are provided with filtration plants, there is great danger of overloading the filter if the source of supply is grossly polluted by raw sewage. The use of water filters should be only an additional factor of safety in an operation which should begin with the proper treatment of sewage. A well-known Canadian authority on municipal engineering has advanced the statement that, "if the domestic sewage which now discharges, by means of underground sewers, directly into streams, rivers, and lakes, without any form of treatment, were treated to the extent of the elimination and destruction of the sewage bacteria, at least fifteen hundred lives could be saved annually in Canada from death by typhoid alone."

The Commission's report refers to water purification by hypochlorite of calcium, which is being very freely adopted in America. Much has been said for and against the hypochlorite or similar treatment. It is recognized however, that as a solitary treatment to obtain pure water it cannot be considered a permanent method. While it would be most unwise not to immediately resort to this treatment in cases of emergency, its usefulness should end there. One of the principal objections to its permanent use is the "residual chlorine" taste or odor acquired by the water in this treatment. It is the opinion of certain authorities on water-purification that to be certain of the destruction of all bacteria, such an excess of the chemical is necessary as to be noticeable to the smell and taste; or vice versa that if there is no smell and taste in the purified water the bacteria are not destroyed with certainty.

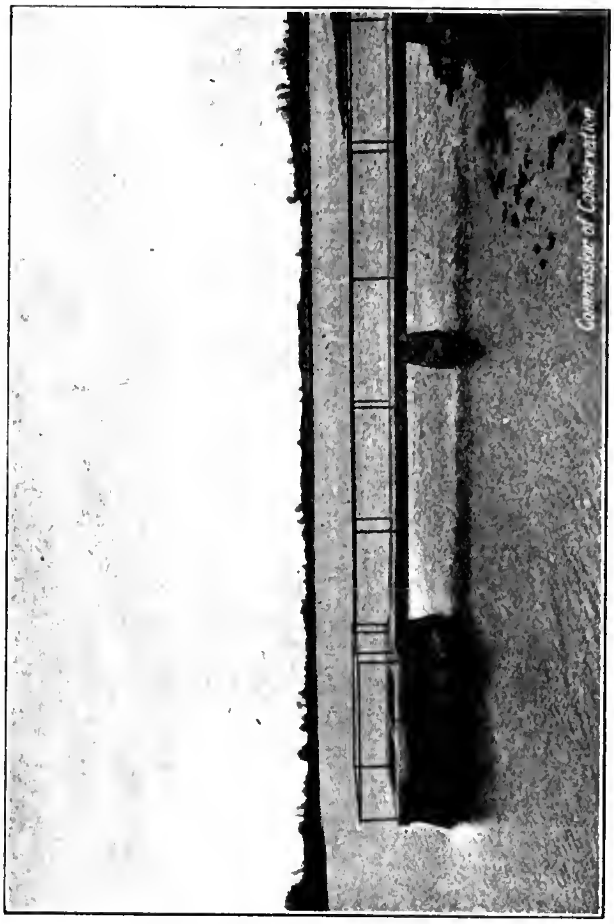
A number of interesting illustrations are included in the report, some of which, through the kindness of the Commission of Conservation, we are reproducing in this issue. They are typical of the methods adopted in water supply and sewerage disposal throughout the Dominion of Canada. The following data refer to the waterworks or sewage systems of the towns to which one or other of the various illustrations refers:

Waterworks

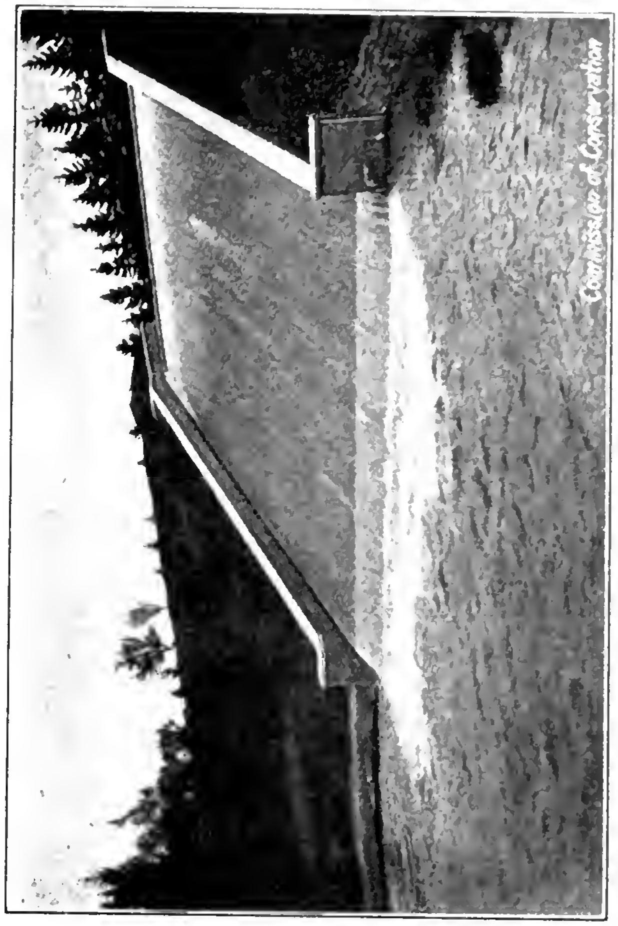
Hamilton—Supply pumped from Lake Ontario, 5 miles distant, into mains; electric power used, with steam auxiliary plant, average 1,200 h.p., maximum, 1,500 h.p. Reservoir: emergency reservoir of 11,000,000 gal., and three others of 2,000,000 gal, 300,000 gal., and 80,000 gal. capacity respectively. Purification: settling basin used. Distribution: 179¾ miles of C. I. mains, 4 in. to 36 in.; 1,782 hydrants; 27,234 services, lead pipe. Pressure: ordinary, 75 lbs.; fire, 60 to 100 lbs. Consumption: 13,500,000 gal. Financial: total cost of plant, $3,466,156; annual maintenance, $117,054; interest, $99,505; revenue, $289,587. Rates: flat rate, on assessment basis up to $4 per $1,000; bathroom, $2.00; meter rate, 7½ cents and 10 cents per 1,000 gal. Officer in charge, A. F. Macallum, city engineer. (Since resigned).

Berlin—Supply pumped from artesian wells, 2 miles distant, to stand-pipe; electric power used with steam and gasoline auxiliary; maximum, 470 h.p.; average, 75 h.p. Reservoir, stand-pipe of 500,000 gal. capacity, illustrated herewith; storage reservoir,

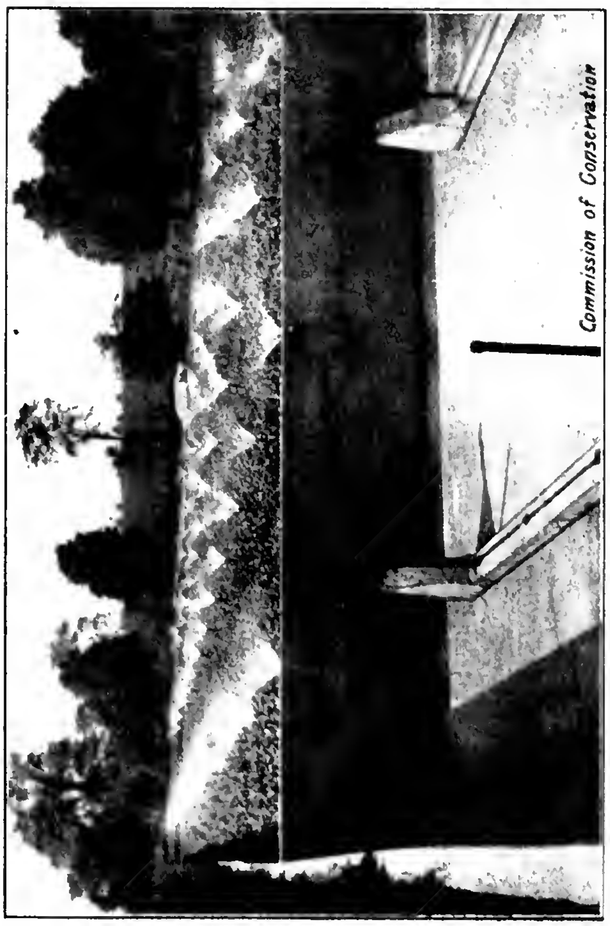
(Continued on page 551)



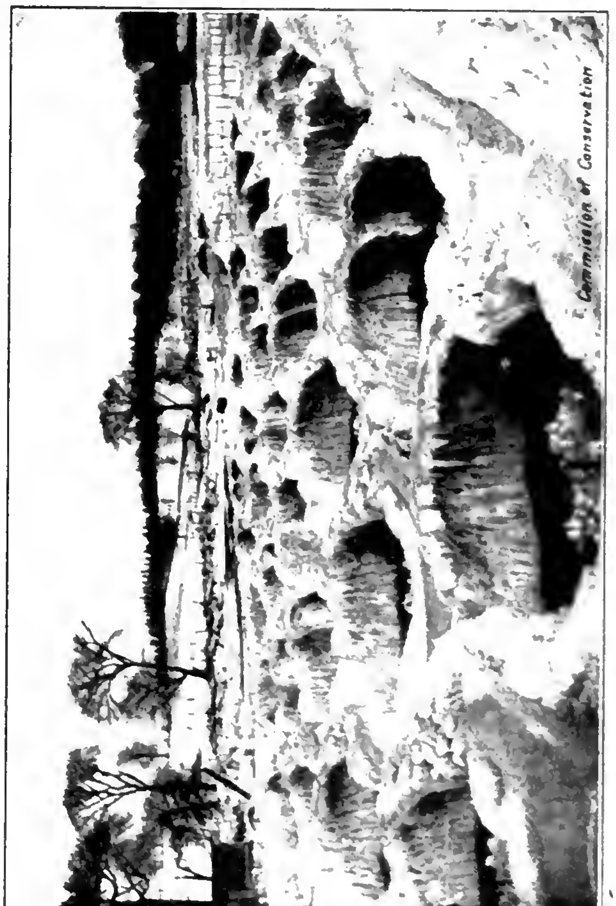
St. Catharines Water-works—24-in. Intake.



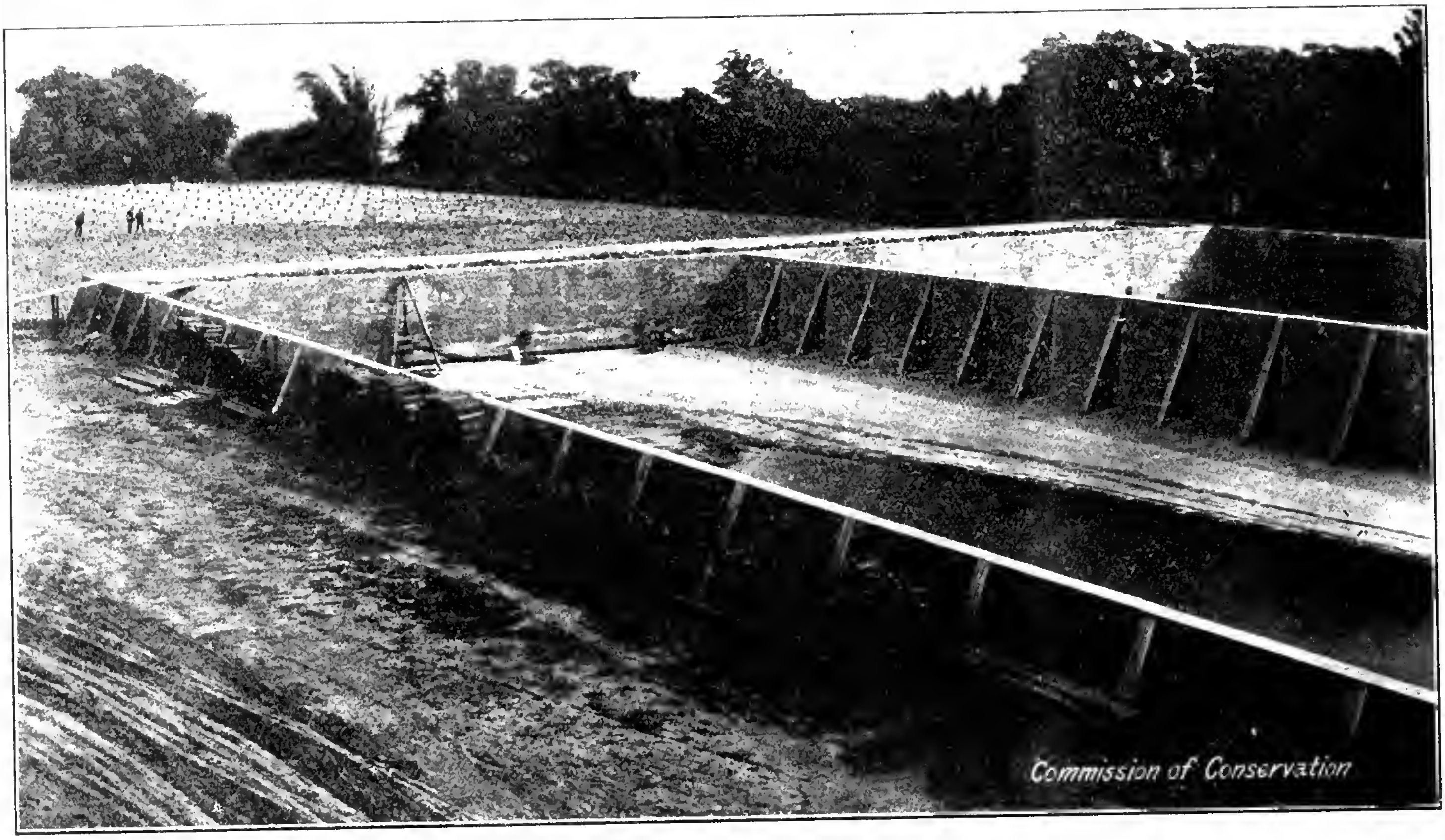
St. Catharines Water-works—Spillway for Surplus Water.



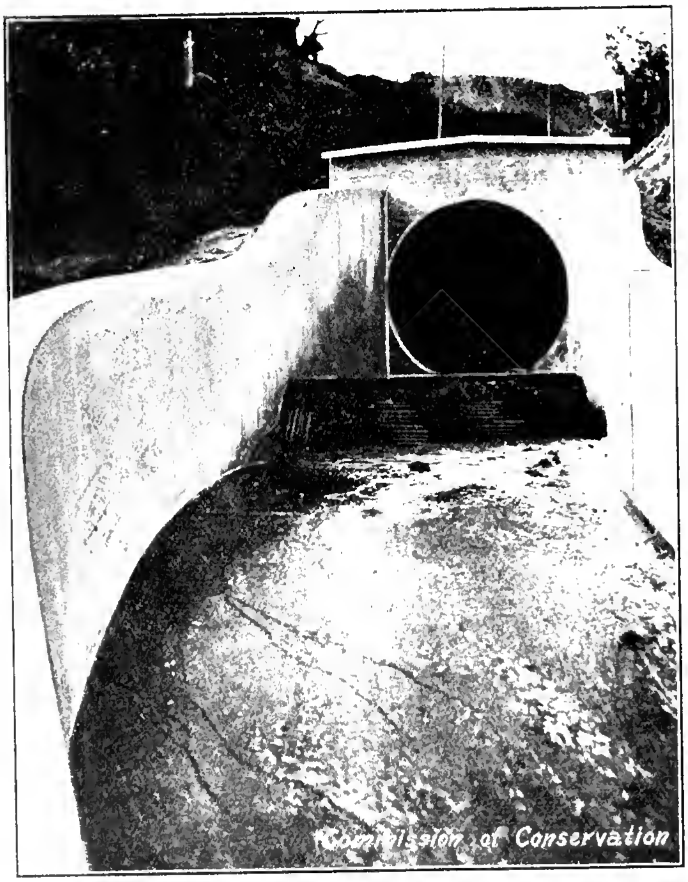
Stratford Sewage Disposal Works—Sprinkling Filters (Summer View).



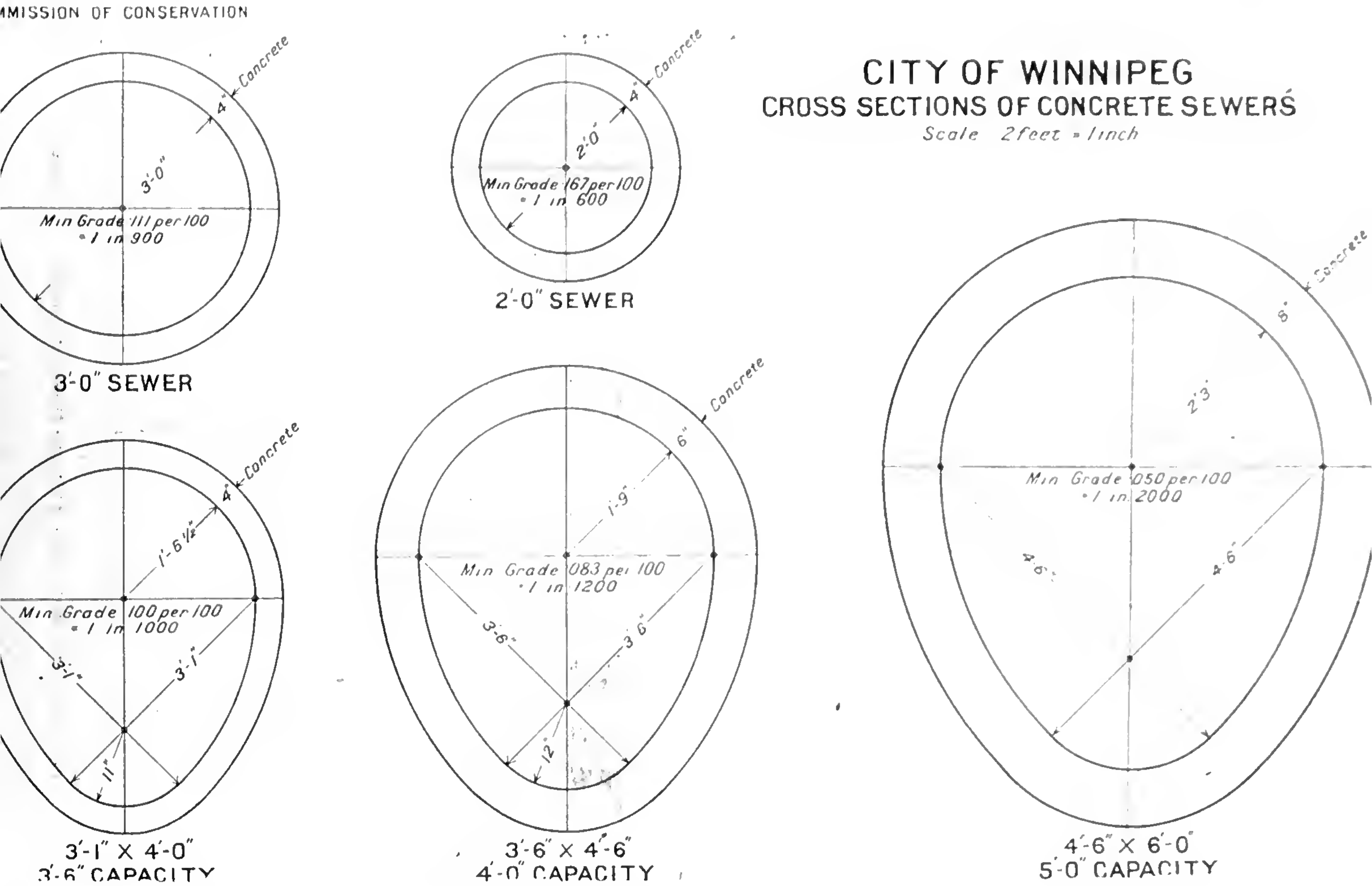
Same as Above (Winter View).

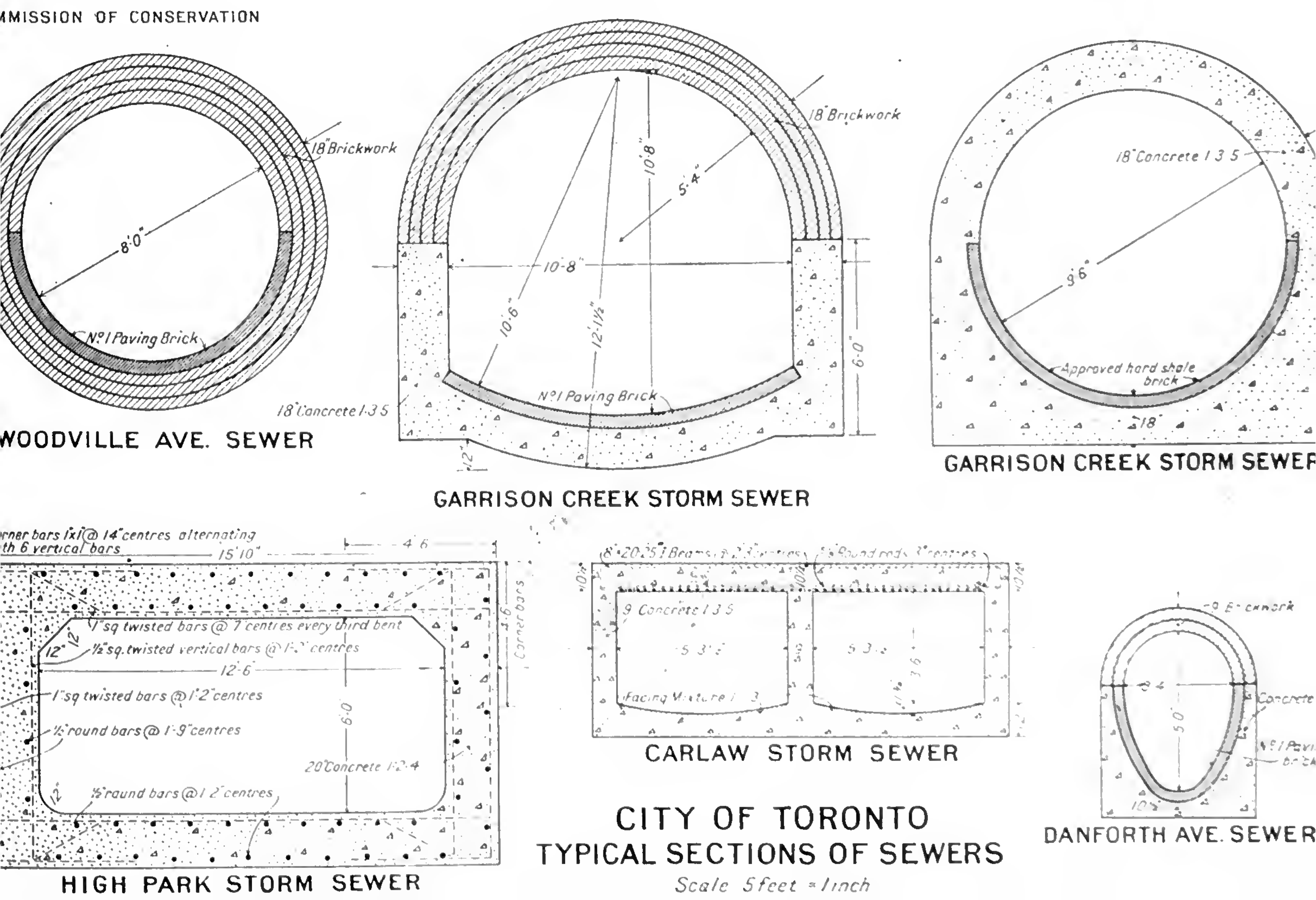


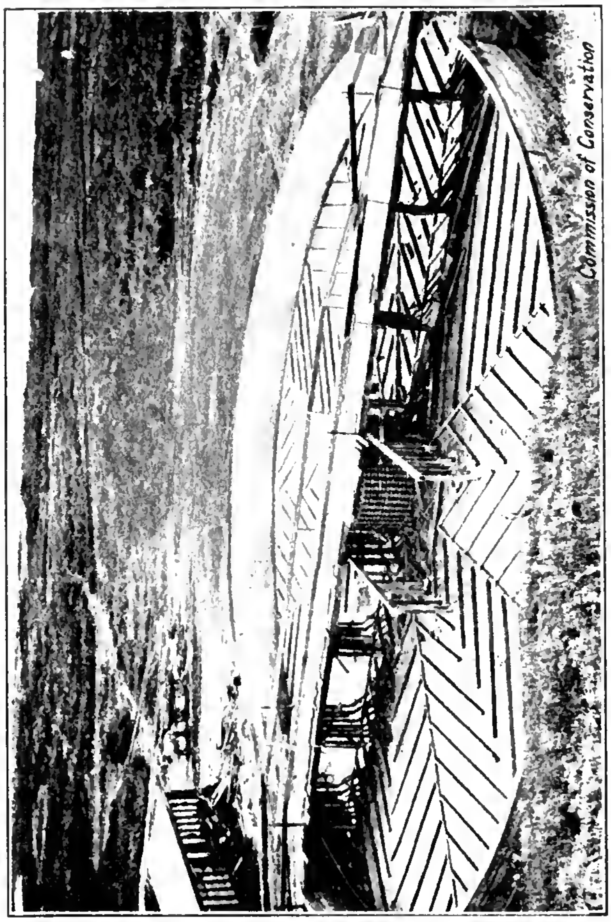
Hamilton Sewage Disposal Works—Tanks and Filtering Beds.



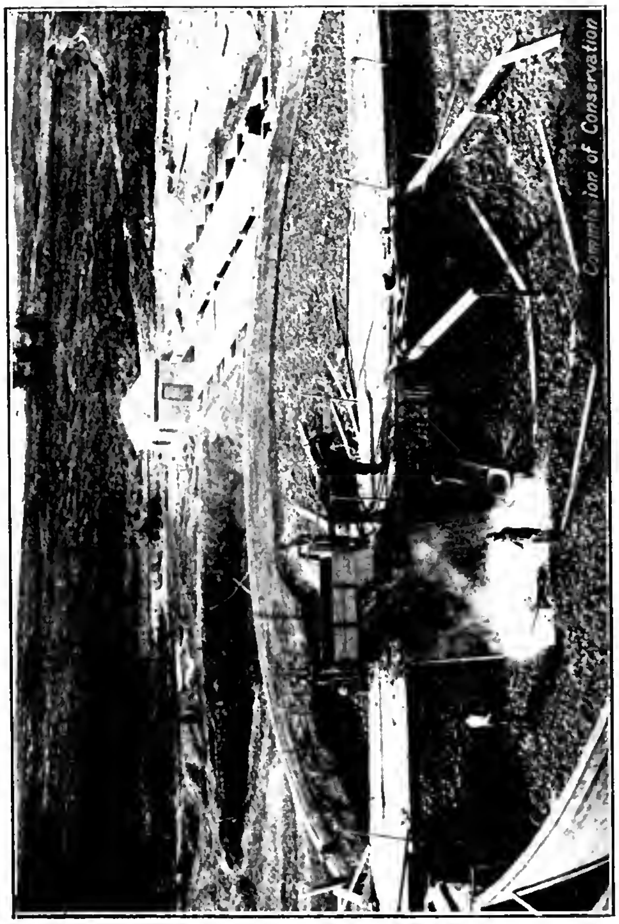
City of Edmonton—Two Views of Sewer Outfall.


MMISSION OF CONSERVATION
CITY OF WINNIPEG
CROSS SECTIONS OF CONCRETE SEWERS
Scale 2feet = 1inch
3'-0" SEWER
Min Grade .111 per 100 = 1 in 900
2'-0" SEWER
Min Grade .167 per 100 = 1 in 600
3'-1" X 4'-0" 3'-6" CAPACITY
Min Grade .100 per 100 = 1 in 1000
3'-6" X 4'-6" 4'-0" CAPACITY
Min Grade .083 per 100 = 1 in 1200
4'-6" X 6'-0" 5'-0" CAPACITY
Min Grade .050 per 100 = 1 in 2000
Concrete

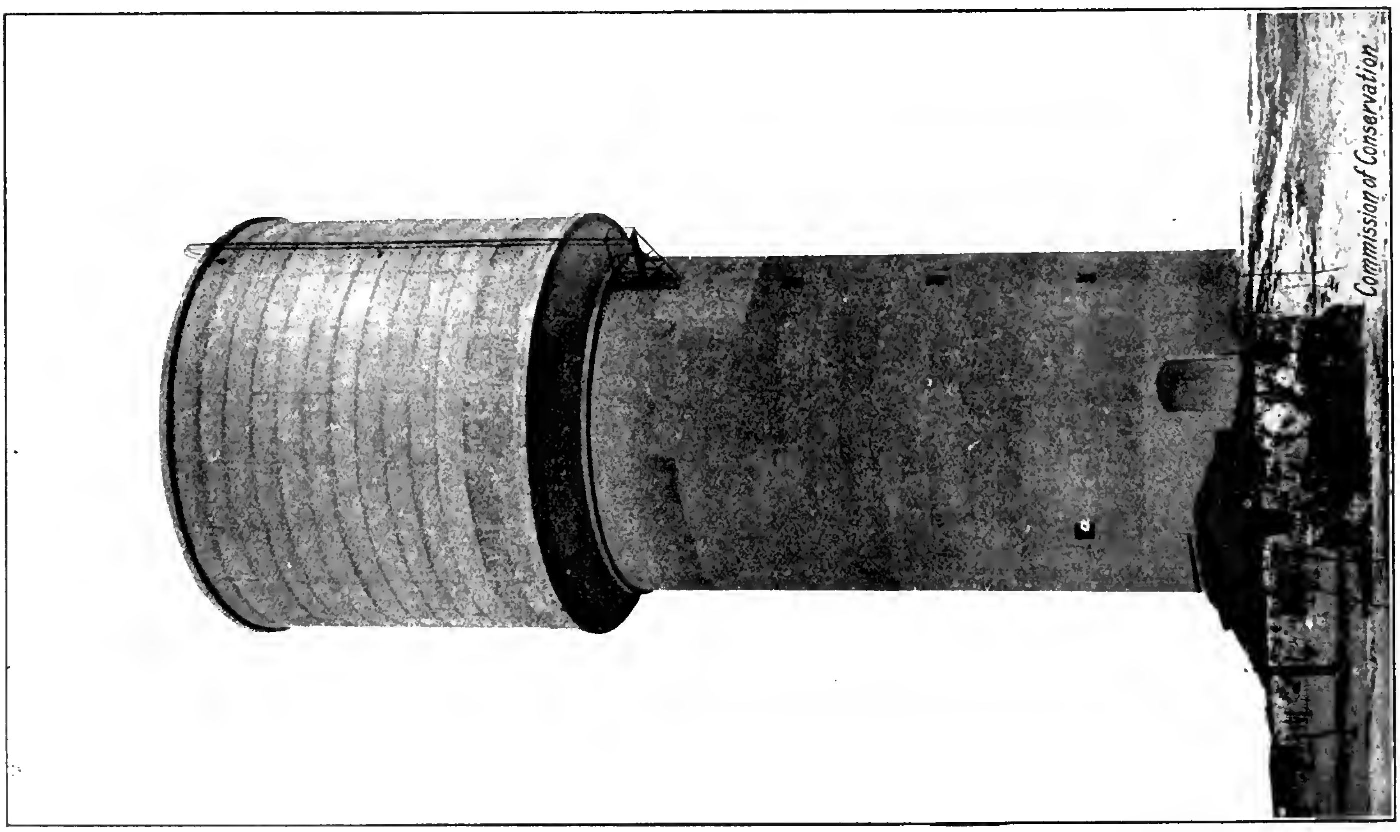

MMISSION OF CONSERVATION
WOODVILLE AVE. SEWER
18" Brickwork
No. 1 Paving Brick
18" Concrete 1-3-5
GARRISON CREEK STORM SEWER
18" Brickwork
No. 1 Paving Brick
GARRISON CREEK STORM SEWER
18" Concrete 1-3-5
Approved hard shale brick
HIGH PARK STORM SEWER
1" sq twisted bars @ 7" centres every third bent
½" sq. twisted vertical bars @ 1'-2" centres
1" sq twisted bars @ 1'-2" centres
½" round bars @ 1'-9" centres
20" Concrete 1-2-4
½" round bars @ 1'-2" centres
CARLAW STORM SEWER
9" Concrete 1-3-5
Facing Mixture 1-3
DANFORTH AVE. SEWER
Concrete
CITY OF TORONTO
TYPICAL SECTIONS OF SEWERS
Scale 5feet = 1inch



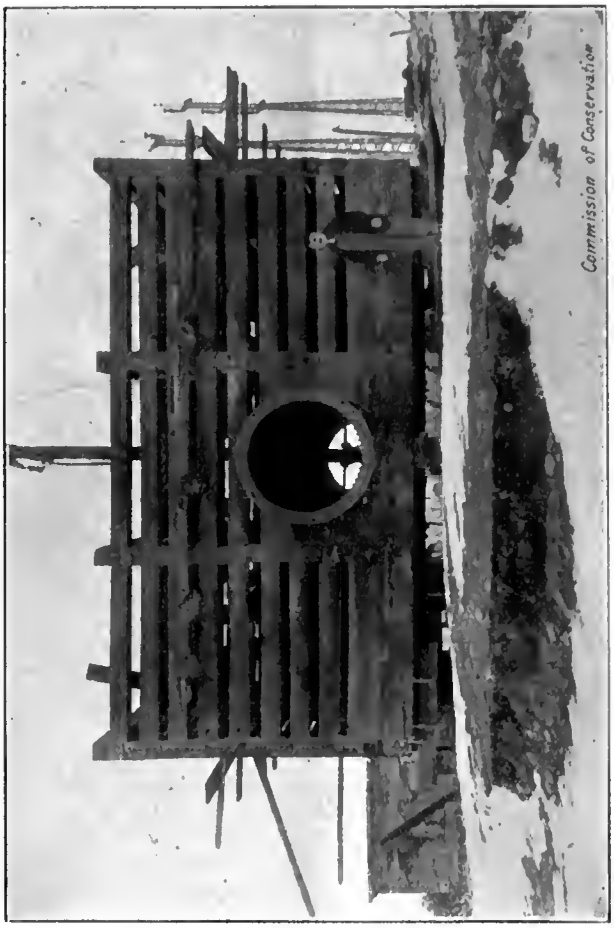
Lethbridge Sewage Disposal Works—Filter before Filling.



Same as Above—Showing Method of Filling; Chlorinating House and Humus Tank in Background.



Berlin Water-works—500,000 gal. Concrete Elevated Water-towe



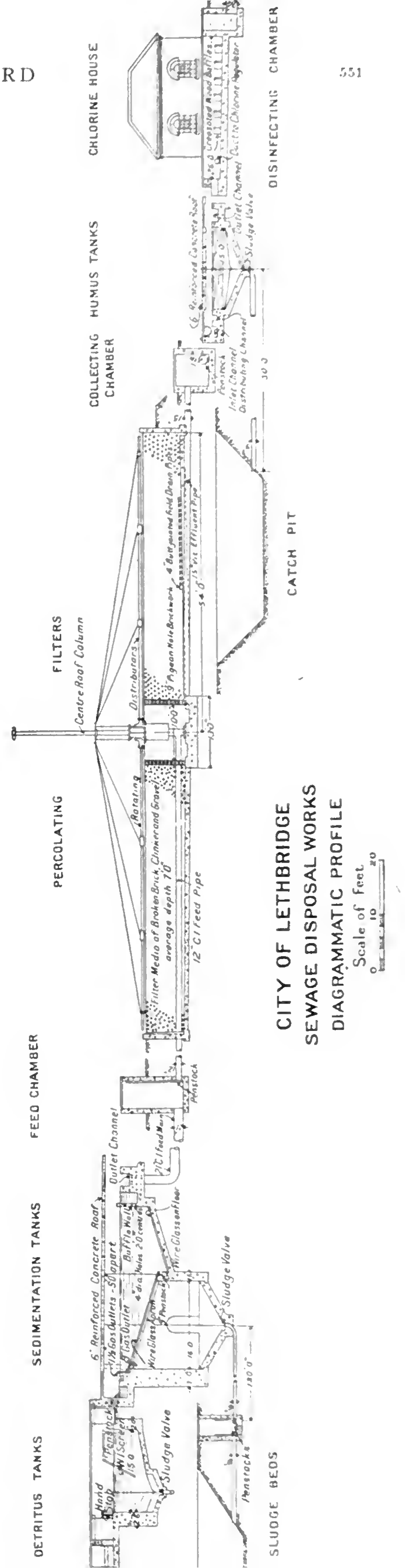
Hamilton Water-works—Crib at the End of 48 inch Intake Pipe.

1,500,000 gal. Distribution: 36½ miles of C. I. and W. I. mains, 1 in. to 16 in.; 271 hydrants; 3,384 services; ½ in. to 1 in. lead and iron pipes. Pressure: ordinary, 75 lbs.; fire, 115 lbs. Consumption: 1,039,000 gal. Financial: total cost of plant, $367,559; annual maintenance, $16,428; interest, $5,242; revenue from consumers, $31,300; from public uses, $5,129. Rates: flat rate, $4 per tap; meter rate, 6 cents to 18 cents per 1,000 gal. Officer in charge: H. Hymmen, superintendent.

St. Catharines—Supply by gravity from Lake Erie, via Welland Canal, 7 miles distant. Reservoirs: 2 of 55 acres and 10 acres area, respectively. Purification: sedimentation and liquid chlorine treatment. Distribution, 53¼ miles of W. I. and C. I. mains, 1¼ in. to 36 in., rock tunnel, 5 ft. by 7 ft.; 364 hydrants; 4,625 services, ¾ in. to 8 in., lead, galv. iron, and C. I. pipes. Pressure: 70 lbs. to 116 lbs. Consumption: 2,750,000 gal. Financial: total cost of plant, $819,813; annual maintenance, $7,000; interest, $24,681; revenue from consumers, $44,220; from public uses, $7,885. Rates: flat rate, $3.50 to $6.00 per dwelling; bathroom, $5.00; meter rate, 4.8 cents to 19.2 cents per 1,000 gal. Officer in charge: A. Milne, superintendent.

Sewerage and Sewage Systems

Edmonton—total of 141 miles of sewers, part carrying combined street drainage and domestic sewage, part carrying these separately. They may be divided as follows: 3½ m. of 6½ ft. to 10 ft., circular concrete; 10½ m. of 44 in. to 72 in. circular, concrete; 4 m. of 27 in. to 36 in. circular, vitrified segment tile; 6½ m. of 22 in. and 24 in. circular, vitrified tile; 18 m. of 15 in. to 20 in. circular, vitrified tile; 98 m. of 8 in. to 12 in. vitrified tile; ½ m. of 6 in. vitrified tile. The outlets discharge into the North Saskatchewan river, part



CITY OF LETHBRIDGE
SEWAGE DISPOSAL WORKS
DIAGRAMMATIC PROFILE
Scale of Feet
0 10 20

MMISSION OF CONSERVATION

of the sewage being treated in a septic tank. Cost of sewers, $3,890,363.

Lethbridge—29 miles of separate sanitary sewers and 2¾m. of storm sewers. The sanitary sewers are divided as follows: ¾ m. of 18 in. x 18 in. wooden box, outfall sewer; 1½ m. of 24 in. vitrified pipe; 3 m. of 15 in. to 22 in. vitrified pipe; 8¼ m. of 10 in. and 12 in. vitrified pipe; 15½ m. of 8 in. vitrified pipe. The storm sewers range from 15 in. to 30 in. The sewage treated in sedimentation tanks, sprinkling filters and chlorinated, the outlets discharging into Belly river; cost of sewers, $275,203; cost of disposal plant, $90,000.

Toronto—total of 480 miles of combined street and domestic sewers, of which the larger ones may be divided as follows: 11 m. of 6½ ft. to 9½ ft. circular; 8 m. of 4¼ ft. to 6 ft. circular; 6 m. of 2½ ft. to 4 ft. circular; 3¾ m. of 6 ft. x 6 ft. to 10¾ ft. x 10¾ ft. culvert type; 9½ m. of 2 ft. x 3 ft. to 5 ft. x 6½ ft. culvert type; 1½ m. of 4 ft. x 6 ft. to 4¼ ft. x 6½ ft. egg-shaped; 3¾ m. of 3 ft. x 4½ ft. to 3¾ ft. x 5¾ ft. egg-shaped; 2½ m. of 2 ft. x 3 ft. to 2¾ ft. x 4¼ ft. egg-shaped. Both concrete and brick are used in the construction of these sewers, the sanitary sewers generally having a vitrified wearing surface of either glazed tile or brick. For sewers carrying storm water only, concrete construction is considered as efficient as any other and cheaper. The larger sewers above enumerated give a total of 46¾ miles, the remaining 433 miles are of 12 in. to 24 in. tile type. The sewage is treated by chlorination and in sedimentation tanks. Cost of disposal plant and trunk sewers in connection with it, $2,792,000.

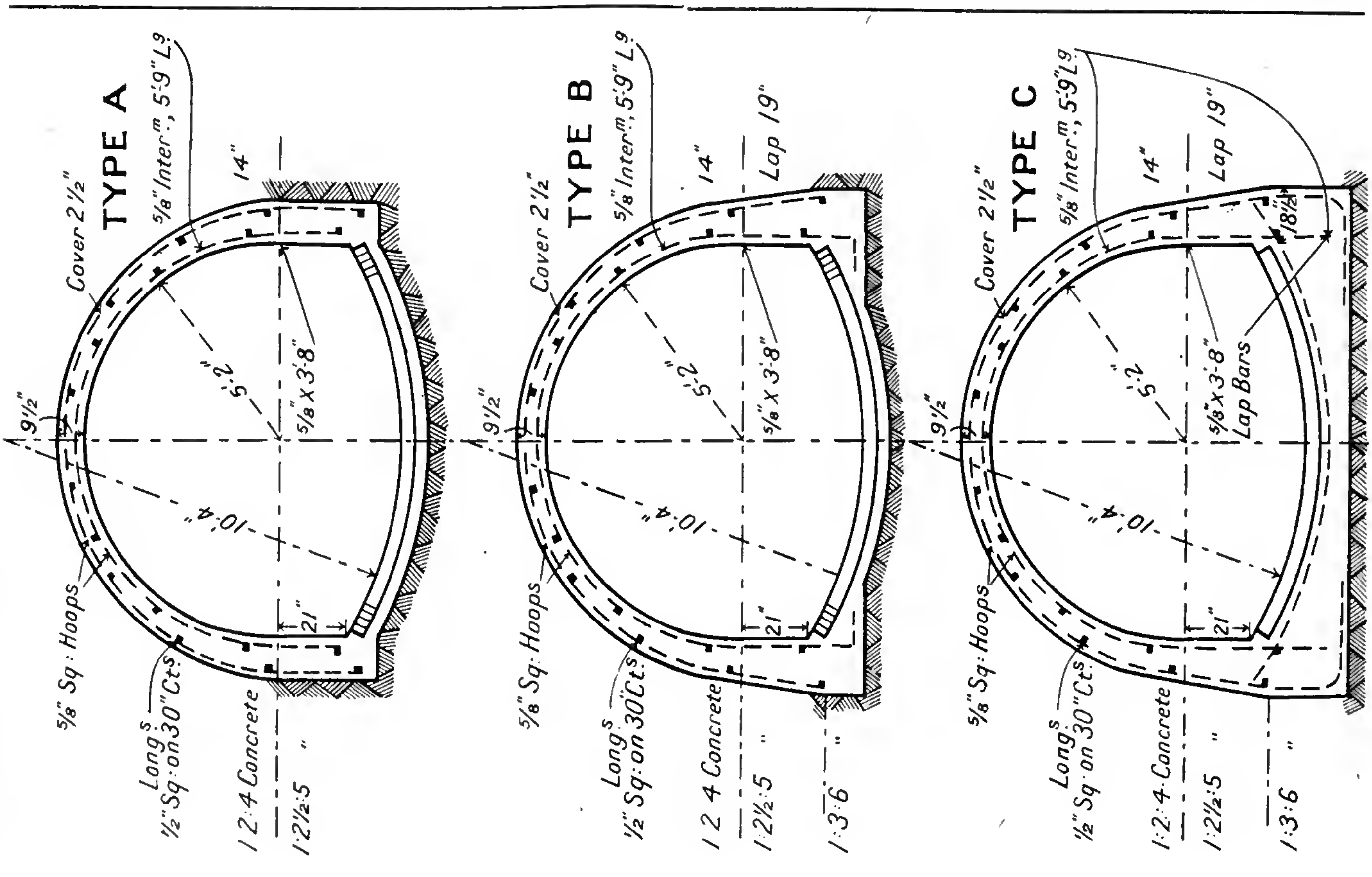
Winnipeg—total of 255¾ miles of combined street and domestic sewers, which are divided as follows: 4 m. of 8½ ft. x 6½ ft. to 14 ft. x 9½ ft. egg-shaped, concrete; 10¼ m. of 6 ft. x 4¾ ft. to 8 ft. x 6¼ ft. egg-shaped, concrete; 7½ m. of 4 ft. x 3 ft. to 5¼ ft. x 4 ft. egg-shaped, concrete; 4¼ m. of 2 ft. x 3 ft. to 7 ft. x 5½ ft. brick; 6½ m. of 2 ft. to 5 ft. brick; 1¼ m. of 2 ft. to 3ft. circular concrete; 90 m. of 15 in. to 22 in. vitrified pipe; 106¼ m. of 12 in. vitrified pipe; ¾ m. of 9 in. vitrified pipe. There are 14 outlets emptying into the Red river and 9 into the Assinaboine river. Cost of sewers, $4,079,053.

Vancouver—200 miles of sewers, the greater part carrying combined street and domestic sewage, with outlets into the Pacific. They range from 6 in. to 84 in. circular section and horse-shoe section equivalent to 10¼ ft. circular, the material being vitrified pipe, cement pipe, concrete, with or without brick or vitrified tile lining. Approximate cost of sewers, $4,500,000.

Stratford—total of 34¾ miles of sewers, part carrying combined street drainage and domestic sewage, part carrying these separately. The sewers may be divided as follows: 2¼ miles of 36 in. and 48 in. circular, concrete; 2¾ m. of 18 in. to 24 in. circular, vitrified pipe; 4 m. of 12 in. and 15 in. circular, vitrified pipe; 24½ m. of 9 in. and 1¼ m. of 8 in. circular, vitrified pipe. The sewage is treated in septic tanks and sprinkling filters. Cost of sewers, $50,000; cost of disposal plant, $60,000.

Nails driven in wood that is exposed to alternate wetting and drying are liable in time to start to work out. The wetting swells the wood and increases its dimensions across the grain, and as the nail is inelastic it is moved, a space forming at the point equal to the amount of swelling of the wood. When the timber dries the nail does not return to its original place, and if tapered it tends to move outward each time that wood is wet and dried. It is for this reason that wood structures bolted together and exposed to the weather require screwing up at intervals.

Messrs. Prack & Perrine, architects and engineers, have moved their office from the Traders Bank Building to room No. 808, Lumsden Building, Toronto, Ont.



Typical Sections Balaclava St. Trunk Sewer, Vancouver, B. C.

The Care and Operation of Belts and Ropes in a Contractor's Outfit

ENGINEERS and contractors who have much to do with the buying and supervision of belts should attend to the little things in their care and operation; they are really more important than the buying. The trouble is that most contractors after buying the belt they believe to be the "best" for their service, hand it over, without further thought, to the foreman, who hacks it up. He pays too little attention, perhaps, to the lacing of the belt or the dressing that should be used to keep it in good pulling shape. Engineers and contractors would do well to pay more attention to how their belts are lined, laced and dressed. They could generally effect a material saving in their plant, as belting is expensive.

Requisites for Good Belts

Manufacturers advise operators to run belts as slack as possible, because, with proper care, they will transmit the necessary power better. The old cast-iron rule of having all belts tight is being done away with and engineers are learning that tight belts are not always essential for the most efficient belt operation.

A few qualities to be desired in a good belt are—first, a good driving surface with sufficient friction between belt and pulley to eliminate slip as completely as possible and to enable the belt to carry its load under minimum tension, thus avoiding useless waste due to bearing friction. Second, lateral stiffness, coupled with pliability; stiffness to keep the belt from twisting and waving and to prevent curling at the edges when shifted, and pliability to enable it to hug the pulley; a pliable belt will lie down close on the pulley and bring into active contact every available inch of pulling surface; pliability in a belt allows it to secure the maximum arc of contact and to alter its shape with the minimum of internal resistance as it travels around and conforms to the shape of the pulley; avoid hard, dry, stiff belts. Third, good tensile strength, that it may carry its load without breaking. Fourth, little stretch and considerable elasticity: the former, so that it will not need to be continually shortened, the latter that it may take up or let go its load as it passes around the pulley. Fifth, firmness and stability, so that the leather springs little when cut, holds its shape, remains straight and runs true around the pulley. Sixth, resistance to external conditions, such as heat, moisture, chemicals, etc., that it may work in any place at any time and wear enduringly. Seventh, low cost.

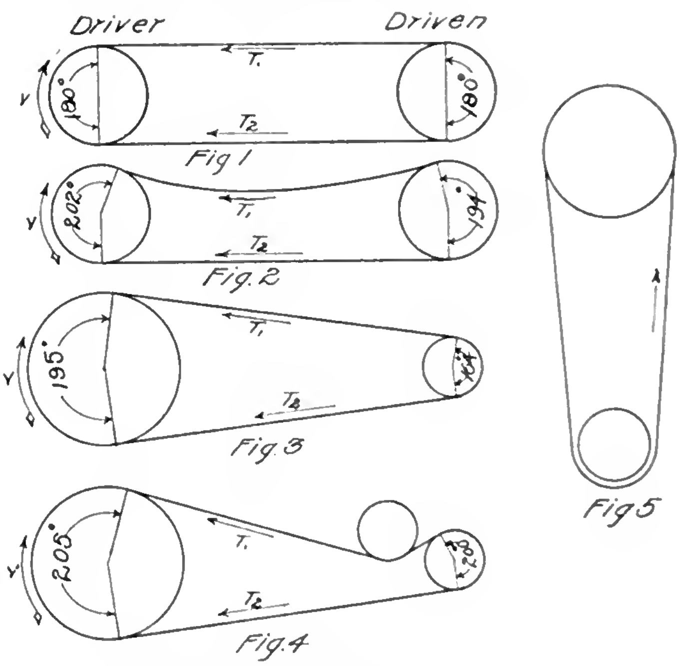
These, of course, if one hundred per cent. efficient, constitute an ideal case, but no leather can have all of these qualities in an equally high degree. Sole leather would do admirably as far as lateral stiffness, little stretch, and firmness are concerned, but would fail entirely to satisfy the demand for pliability, tensile strength, elasticity, etc. The best results from leather belting are necessarily somewhat of a compromise.

Care of Belts

The most important item in the care of belts is to keep them from getting hard and dry. On the other hand, trouble is often occasioned by belts becoming oil-soaked and when travelling at a high rate of speed jumping off and destroying themselves. Pulverized lime is very good where the belt is wet with oil or water. Pulverized chalk, phosphate dust, cement, fire clay, or fine ashes, would do as well, the idea being to get the dust to absorb the oil or moisture. The oil-laden dust may be easily scraped off the belt or pulley or it will sometimes roll up in balls and drop off of its own accord. Linseed oil is good for cotton or canvas belts, especially in damp places or warm climates, while neats-foot oil is a very good dressing for leather belts. Care should be exercised in using substitutes for belt dressings, however. The extravagant use of those mentioned may soon ruin a belt. Keep on hand a good belt dressing; it will prolong the life of the belt.

Splicing

The idea that a belt is a belt and that one need merely cut off a piece of the requisite length and put it on the pulley, is no longer tenable. Proper mechanical conditions and adaptation of belt to drive, are just as essential to economy of operation as is the choice of an electric motor to the work it has to do. The trouble with too many foremen is that they look no further than the belt itself.



Belt Gearing for Securing Maximum Efficiency

The splicing of the belt is a big factor in prolonging its life. The endless or cemented belt is the best type, but where it cannot be used handily a lacing that most closely imitates it is the next best thing. Lace joints should be pliable to allow them to hug a small pulley. Belts are cemented more easily nowadays than they were formerly, because of the improved equipment. A belt is simply sliced twice to the proper bevel line, thus cutting out the old splice, cemented, set together and placed under a press. The usual cement employed to stick the laps has for its basis animal glue. This cement will usually hold as long as the leather lasts. Modern waterproof cement is unaffected by either hot or cold water.

There is some controversy as to whether leather or wire is the best for laced belts; whichever under the conditions will most closely approach the condition of an endless belt should be used. Poor lacing is one of the principal causes of belt deterioration.

In leather lacing care should be taken in punching holes. It was often thought that the more lacing, the stronger the joint. This may be true in so far as the laces are concerned, but each extra hole decreases the cross section of the belt and therefore its tensile strength.

The wire joint is fast approaching the desired condition of an endless belt. Wire joints are fairly quiet in operation, can be joined to run without a jump, and are almost as flexible as the cemented joint both laterally and longitudinally. They are almost as strong, too, because little of the belt section is punched away, the wire prongs merely displacing the belt fibres by pushing them aside. Make belts endless or make them approach that limit, as nearly as possible, is a good rule.

Belt Gearing

The average thickness of single belts is 7/32 in., and the weight of the average 7/32 in. leather belting is .0911 lbs. per inch width of foot length. The maximum tension for the driving side of a single belt should not exceed 90 lbs. per inch width for cemented or riveted belts and 70 lbs. per inch width of laced belts.

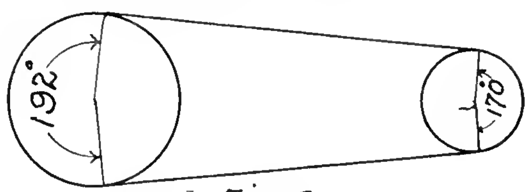


Fig. 6

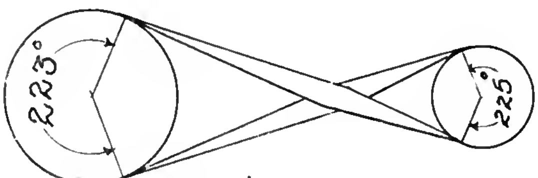


Fig. 7

Crossing Belts to Secure a Maximum Arc of Belt Contact

The allowable maximum velocity for single ply belts is 4,500 to 6,000 feet per second. This velocity may be determined more closely for any particular case by using the formula: $V = 196.5 \sqrt{T_2/w}$. Where V is the maximum velocity, T_2 the tension per inch width for the belt on the driving side, and w the weight per inch width of foot length.

The horse power that a given belt will carry may be found from the formula:

$$\text{H.P.} = \frac{(T_2 - T_1)\,V}{33000}$$

Where T_2 is the tension in pounds per inch of width on the driving side, T_1 the tension on the driven side.

A good approximation for horse power is: bv/870 for cemented belts or bv/1117 for laced belts, where b is the width of the belt. This same equation may be used to approximate the width of the belt required to transmit a given horse power at a given speed.

The following table may be used for determining the horse power that given belts will carry under average conditions.

Single Belts

Width	Cemented	Laced
2 in. to 6 in.	H.P.= bv/1000	H.P.= bv/1300
above 6 in.	H.P.= bv/ 900	H.P.= bv/1000

Double Belts

up to 6 in.	H.P.= bv/500	H.P.= bv/650
6 in. to 10 in.	H.P.= bv/450	H.P.= bv/550
above 10 in.	H.P.= bv/380	H.P.= bv/480

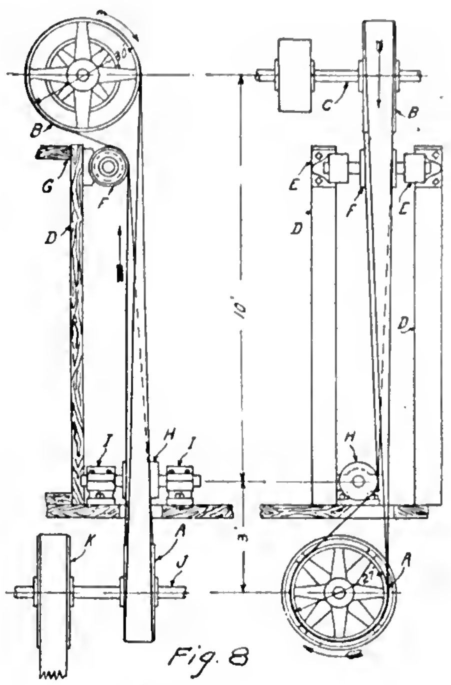
Single belts are not made above 12 inches in width.

Pulley Arrangement

No absolute rule for an ideal arrangement of pulleys can be laid down, but there are a few general rules that should be followed in working out the best arrangement of belt gearing. The driving power of a belt depends on the frictional resistance, F, which depends on the frictional coefficient, f, the arc of contact and the width of the belt. The frictional coefficient, f, depends on the nature of the surface and may be increased by the proper treatment of the belt to make it soft and pliable so that it will hug the pulley surface in passing around it. The arc of contact is probably the most important factor in the efficient operation of belts. Fig. 1 shows an arrangement of pulleys connected by a tight belt running at the same rate of speed. The arc of contact is 180 degrees in each case. If the distance from centre to centre is great enough, a heavy belt running slack may give better pulling power than the tight belt, because it increases the arc of contact, as shown in Fig. 2. A rough rule that may be applied in such cases is that every degree of belt contact increases the pulling power by 1/360. If two pulleys are connected by a tight belt the bearings are under high tension and therefore consume considerably more power than do the bearings in Fig. 2 after the initial tension is relieved.

A great deal may be said, pro and con, for slack belts. In some cases, for instance, where shafts are spaced very closely centre to centre, they will not work, especially if the horse power to be transmitted is considerable. Much depends upon the distance between the shafts, the character of the drive—gas, steam, or electric motors—and the character of the driven machinery. One of the chief advantages of slack belts is the fact that they seldom have to be taken up. Most of the time otherwise spent in splicing is thereby saved.

In such a drive as Fig. 3, where the driven pulley is required to run at a high r.p.m., much trouble will result if it is driven directly by a tight belt from such a large pulley as shown. If the r.p.m. of both pulleys is fixed, an idler should be used to increase the arc of contact, otherwise the percentage of slip may rise to unsafe proportions, as the arc of contact may be only a small fraction of the pulley surface. Fig. 4 shows how the arc may be increased by the use of an idler. Such an idler need not be heavy and need have no additional weights attached. As a rule its own weight is sufficient to effect the desired change. It should, however, be well machined and perfectly aligned, for the ultimate efficiency depends on this accuracy. A well proportioned and properly aligned pulley consumes very little power, but if it is not in good alignment it may become a regular coal consumer and the power gained by the increased arc of contact may not be sufficient to overcome the loss due to poor alignment. In cases where an idler is employed an endless belt should be used, since the idler runs on the opposite side to what the pulleys do. A thick lace joint will cause a jump or jar every time it passes around the idler. Leather belts are best because they can be made endless by cementing.


Method of Making a Quarter Turn with Belts

In vertical drives idlers prove a saving, because with a vertical drive running at a high rate of speed, the centrifugal effect of the belt may cause it to leave the lower pulley face entirely, as shown in Fig. 5, and allow the driven pulleys to come to rest. This centrifugal effect may be overcome by the use of a spring idler.

Another method of increasing the arc of contact is by crossing the belt, as shown in Fig. 7. This method depends entirely, however, on the direction in which the machines have to run.

Transmission Efficiency

Any arrangement that will decrease slip and increase the frictional factor, F, will prove a saving. Belt slip creates friction and where power is consumed through friction either by belt slip, belt creep, journal friction or windage, fuel is unnecessarily spent thereby. Every per cent. of slip costs approximately one per cent. of the fuel. In average belt gearing with a low pulley ratio, the belt slip seldom runs higher than 5 per cent., and with a good gear it averages about 3 per cent. with good belts. This leaves a belt transmission efficiency of 95 per cent. Of this approximately only 3 per cent. is actual slip, the remainder being creep. This creep cannot be avoided, and that is one reason why average leather belting transmission efficiency never runs above 98 per cent. Slip can be avoided, and with well oiled bearings, good shaft and pulley alignment, a well-cared-for non-slipping belt, a belt transmission efficiency of 97 per cent. should be maintained right along.

Care of Manilla Rope

Contractors with extensive equipment necessarily require for its operation a great deal of rope of various sizes and lengths. Possibly there is no article in the contractor's outfit which receives more abuse than manilla rope.

Manilla hemp, of which most ropes are manufactured, at least all rope over 1 inch in diameter, is a vegetable fibre and is susceptible to the action of water and air, the same as a piece of unprotected wood. In fact the hardest wear on a rope is exposure to all kinds of weather. This cannot be avoided in construction work. Contractors would do well, therefore, to pay a little attention to the conditions for preserving rope in service. Ropes in service deteriorate in two ways—by the wear on the outer surface that can readily be seen, and the stretching, bending, crushing and breaking, of the inner fibres that cannot be discerned without careful examination. The wear on the outer surface may be accelerated by ropes rubbing against each other or by dragging across hard surfaces, or by running over sheaves having too small a groove or too small a diameter consistent with the load upon it.

Ropes do not give out all at once, and therefore need much careful attention. Rope failure is more likely to be due to overloading than to any other cause. A rope subjected to overloading will show it by the twist coming out or by the strands jumping out of their proper place. Ropes in service on heavy work, such as pile-driving, steam shovel or crane work, hoisting, etc., should never have the load applied suddenly or with a jerk, because the stress set up in the rope will be many times that of the weight to be lifted, and if it does not result in the failure instantly, will probably cause deformation which will start deterioration. Sudden stress applied to a rope with a kink in it may result in instant failure or in any case will cause a loss of strength. Ropes used on derricks, cranes and pile-drivers, which have to handle heavy loads over small diameter sheaves, wear out very rapidly, while ropes of the same diameter working over large sheaves will handle the same load for years.

In passing over a small sheave the rope is subject to sharp bending which causes the fibres to slide slightly on each other and, being rough, the friction causes them to break. Running a rope over two small sheaves, bending first in one direction and then in the other, necessarily exaggerates the trouble.

Rope that has been wet or muddy should be cleaned after use and stored in a well ventilated place. Wet rope placed in a box or a small unventilated store room is likely to rot or ferment rapidly and become worthless in a short period of time. Tarring ropes may be employed when they are subject to considerable wet and comparatively little stress, but should not be used on ropes on cranes or derricks subject to heavy service, as the tar cracks when passing over small sheaves. A rope should not be allowed to freeze after becoming wet, or if frozen should not be used, because the fibres will break; neither should it be piled against radiators or steam pipes for obvious reasons. On the other hand, a rope may be seriously damaged by becoming too dry because the fibres become brittle.

These are a few conditions which, if guarded against by a competent foreman, will prolong the life of the plant and reduce the operating expenses. In nine cases out of ten, abuse of rope is due more to the lack of knowledge than to wilful neglect.

An effort is to be made to cheapen the cost of laying asphalt pavements in Montreal. Mr. P. Mercier, the chief engineer, has issued instructions that $1.90 per yard is not to be exceeded, this comparing with $2.14 last year. The saving is to be made by more efficient administration.

Foundations and Their Treatment

Bearing Power of Sub-soils — The Design of Different Types of Foundations to Meet Different Local Conditions

By M. T. Cantell

ALTHOUGH from an artistic standpoint the foundation of a structure is a minor detail, yet as regards the stability it is of the greatest importance and demands the utmost consideration and knowledge of the designer.

The kind of foundation necessary for any structure depends upon the condition of the subsoil and its bearing power. If this is not of sufficient strength in its natural condition the soil or the foundations, or both of these,must receive special treatment. The subsoil must have sufficient bearing power to directly support the dead load of the structure plus the pressure caused by external forces such as traffic, moving machinery, wind, earth, water, or other forces to which the structure may be exposed.

Special Treatment for Heavy Buildings

Special treatment is seldom necessary for light structures on ordinary soil that has not been disturbed from its natural condition, but the weight of heavy structures will often greatly exceed the bearing power of the soil upon which they are to be erected, consequently, if the foundations do not receive due consideration settlement will occur and the stability of the structure will be seriously affected; such results are unfortunately very frequent and are in most cases due to carelessness or neglect of the designer or contractor. Faulty foundations, however, are not responsible for all settlements, very many structures large and small have settled owing to subsidences caused by colliery workings, tunneling, sewering, and other work requiring deep excavations. Also by water finding its way to and percolating through the subsoil and gradually draining away the light constituents after the structure is erected.

Variation of Bearing Power of Subsoils Explained

The bearing power of subsoils vary considerably; made-ground simply tipped and spread in position will settle under its own weight about three inches for a depth of eight feet; if, however, the same earth be well pounded in layers it can be made to support as much as one ton per square foot without any appreciable settlement. A layer not less than a foot thick of broken stone well rammed on top of loose earth will support three-quarter ton per square foot. Light earth and sandy loam in their natural condition will support three-quarters to one and one-quarter ton. Wet sandy gravel one and one-half ton. Compact gravel in thickness not less than twice the depth of the footings will support as much as three tons per square foot; if of considerable depth, four tons. Compact gravel and earth, three tons. Compact dry gravel without clay and overlying rock will support as much as six to seven tons; if there is clay between then three tons only. The bearing power of clay alone will vary from one to seven tons or more, according to its nature and its depth below the surface. All soils increase in strength with depth, but, with some, the increase is more than with others. With gravel and sand it is very slight, but with clay it is considerable. The average bearing power of good compact clay not nearer the surface than ten feet is about two tons per square foot, at a depth of 15 to 20 feet, three tons or more; a good stiff blue clay at this depth will carry as much as five tons or more per square foot.

Sand although generally considered entirely useless to build upon if of considerable depth, in a dry state, confined and not likely to be disturbed by water is practically incompressible and will safely support as much as five or six tons per square foot, but, as it is not possible to tell what may happen in the vicinity at some future time to alter the conditions, this class of foundation should be looked upon with suspicion and treated with caution.

Soil and Foundations Often Need Special Treatment

Now a cubic yard of granite weighs approximately two and one-quarter tons; sandstone and limestone, two tons; concrete, one and three-quarter tons; brickwork, one and one-half tons. It is, therefore, obvious that with most structures, the weight upon one square foot of the foundation is greatly in excess of the amount that one square foot of soil can bear, for, with the above values, we see that a wall 27 feet high, built of granite will load the foundation with two and one-quarter tons per square foot; if of brickword, one and one-half tons, and this from the weight of the wall only without considering the structural or other loads carried by the wall, consequently the soil must be strengthened or the foundations designed so that the limit of bearing power is not exceeded, sometimes it is necessary to give both soil and foundation special treatment.

Safe Load Usually One-quarter or One-fifth of the Crushing Power

The safe loads for the various materials used in foundation work are generally taken as one-quarter or one-fifth of the crushing loads. All materials vary considerably in quality, consequently no two varieties of one class will have the same strength; the following, however, can be taken as the safe loads for the respective materials of average quality.

Common brickwork in lime mortar, gauged one to three, three tons per square foot; good pressed brick in cement mortar, gauged one to two, ten tons per square foot; good pressed brick in cement mortar, gauged one to three, eight tons per square foot; lime concrete, gauged one to six, three tons per square foot; Portland cement concrete, gauged one to seven, eight to ten tons per square foot; limestone and sandstone, according to quality, six to twelve tons per square foot.

In considering the class of foundations to be used for any structure there are other factors, in addition to the bearing power of the subsoil, which demand careful consideration. The chief of these are: the comparative cost of materials; convenience of the locality and convenience of access to site. With the last the greatest difficulty occurs with those to be constructed entirely under water; but in whatever position, or under whatever conditions, the principal point to be considered is the prevention of unequal settlement and in some cases side slip or lateral escape of the soil. All structures settle more or less even through the compressibility of mortar joints, but no structural harm will result if the setlement is uniform throughout.

Foundations Should be Incompressible

A good foundation should be as solid and incompressible as possible. If the soil is stratified the pressure caused by the weight of the structure should act at right angles to the strata. If the foundations cannot be designed to admit of this there will be danger of side slip which must be prevented. If the site is inclined the bed of the foundation should be benched out frequently. On inclined sites the strata is sometimes liable to slip under the benches. This can only be prevented by piling along the lower side of the foundation. If a spring is found crossing the site it should be diverted around the building by means of a specially constructed channel or by pipes and carried into its original course below the cite. Catch drains should also be provided for surface water.

Determine the Soundness of the Site

Before designing the foundations of important structures the soundness of the site should be determined. This is generally done by boring with an auger and examining the borings taken from a depth depending upon the weight of the structure to be erected; if the borings show soil of a satisfactory nature the bearing power at the required foundation depth should then be determined. This can be done by excavating pits sufficiently large to enable a bearing plate, preferably two feet square to be placed in position without disturbing the soil upon which it is to rest; this plate should then be gradually loaded and the rate and extent of settlement carefully observed both during loading and at least 24 hours after loading. Upon the result of this test the safe load for the soil can be determined and the foundation designed accordingly. Pot-holes or soft places should be excavated and filled in with gravel or broken stone carefully rammed and made as nearly as possible equal in bearing power to the surrounding soil. If there are any drains, sewers, or other pipes passing through the site that cannot be removed the walls should be arched over them leaving a clear space of several inches between the drain or pipe and the soffit of the arch.

What Constitutes Good Foundations

Solid rock free from clay holes, rotten parts and serious faults or shakes provides a good foundation and only needs levelling for the footings; this, however, generally involves considerable labor resulting in costly work. Beds of rock with partings of clay between them are not to be trusted, being liable to slip, particularly if the beds are inclined.

Gravel, if compact and not liable to escape sideways under pressure, is one of the best soils to build upon. If well graded from fine to coarse it is almost incompressible; is easily levelled and is not affected by exposure.

Sand, if confined so as to prevent lateral escape under pressure in a dry state and not likely to be disturbed by water, is also practically incompressible and will provide a good foundation, but at all times this class of foundation should be looked upon with suspicion and treated with caution.

Clay is, as a rule, reliable from a constructional point, but from its dampness it is an undesirable soil upon which to erect dwelling houses. It is also subject to considerable èxpansion and contraction as the moisture it contains varies with the temperature or with the subsoil drainage. If subjected to the heat of the sun it will shrink and crack. These cracks will become full of water through rain when expansion with great force takes place with probably serious results to the structure. Similar expansion also occurs with the moisture freezing during the winter, consequently, foundations on clay should be carried sufficiently far below the surface to be beyond atmospheric influence.

Portland Cement Concrete Forms an Ideal Foundation

An ideal foundation for a building is a solid bed of Portland cement concrete reinforced with steel rods spread over the whole of the site extending two or three feet beyond the walls, with a thickness depending upon the nature of the ground. The reinforcement increases the transverse strength, also greater strength is obtained with less depth than would be required if plain concrete were used. Many fairly large buildings have been floated, as it were, on made ground not much better than mud in this way and have stood without crack or settlement.

The concrete if not be be reinforced should be composed of Portland cement and broken hard limestone or sandstone, granite or trap rock, brick or gravel, which must be entirely free from clay, organic refuse and other impurities and sufficiently small to pass through a 2½ inch mesh. For ordinary purposes suitable proportions are 5 parts of aggregate, 2 parts of sand and 1 part of cement. The aggregate is best if damp before using but not dripping wet. If it is very rough and porous the proportions of cement and sand should be greater as a good deal is absorbed into the pores of the aggregate. The amount of water required for mixing will also vary with the absorbent nature of the aggregate. Therefore, a definite quantity cannot be specified, but sufficient should be used so that when well mixed the mass will be of a pasty consistency or what is known as a medium wet mixture. On no account should it be so wet as to flow out almost like a liquid. It should require light spreading and tamping to properly fill the forms. At the present time the general tendency is to use a very wet mixture which means an excess of water. This is economical for the cantractor, particularly if the concerte is deposited by chuting, as it flows easily and requires less spreading. There is also a general idea that less or no tamping is required as the mass sets sufficiently dense without it. This idea is not correct. There is a lack of density which is the chief reason why an excess of water should not be used, particularly in reinforced concrete as it results in a more porous concrete of less strength than would be obtained with less water and more tamping.

Neat cement requires 18 per cent. by weight of water to mix it, or about 2 gallons per bushel or 1¼ cubic foot; approximately half only is necessary for the whole bulk of concrete or generally from 20 to 25 gallons per cubic yard.

Correct Mixing of the Concrete is Important

When mixing is done by machine the whole mass should be in continuous motion within the machine for a period of not less than one minute. Machine mixing produces the best results and should be resorted to wherever practicable. If mixed by hand it should be done on a clean and water tight platform, the cement, sand, and aggregate being thoroughly mixed while dry by being turned over two or three times after which the water should be sprinkled on through a hose while the mixture is again turned over at least twice. No concrete which has partly set should be knocked up again for use unless as aggregate.

Depth of Concrete in Foundations

No definite rule for the depth of foundation concrete can be given as this depends upon the nature of the soil and the projection beyond the face of the wall, but it should not be less in depth than 1½ times its projection. It should always be remembered that two feet depth of good concrete is better than four feet of bad, also that the purpose of concrete is to distribute the load uniformly over as large an area as necessary and that excessive depth will not be of value in this respect, but will only increase the load to be borne by the subsoil. Therefore, in bad ground there is nothing to be gained by an unusual depth unless it is carried to a firmer bottom. Where it is necessary for the width of concrete to be considerably more than the thickness of the wall it need not be carried up the full width for the whole height as generally it is as strong or stronger than the material of which the wall is built. It can, therefore, be reduced in width as is seen in Figs. 4 or 5, the slope not exceeding 45 degrees or less with a wet mixture, or boards will be required to keep the concrete in place until it has set. If the bottom of the trench is wet or in a sloppy condition, dry ashes or clinkers, not sand, should be lightly spread over before the concrete is placed. If it is required to place the concrete entirely under water it should be gradually lowered in a bucket with a hinged bottom fastened with a catch on the outside to which is attached a cord and trigger. A cord rammer should also be used. This method can be adopted only in still water.

Designing Piers

When the soil at a conveniently accessible depth is of a satisfactory nature and requires no special treatment to increase its bearing power, it is only necessary to determine the area of soil to be covered by the foundation, so as to permit of a safe and uniform pressure under the whole structure. To determine the dimensions of a pier and its foundations the following steps are necessary:—

(1) Estimate the load to be carried by the pier.

(2) Estimate the approximate weight of the pier.

(3) Determine the sectional area of the pier by dividing the sum of loads 1 and 2 by the safe load for the material of which the pier is to be built.

(4) Add to the load and weight of pier the approximate weight of footing courses, then divide the total load thus found by the safe load for the concrete which will give the spread of the footing courses.

(5) Add to the load used for number 4, the approximate weight of foundation slab, then divide the total load by the safe load for the soil, which will give the area of soil to be covered by the foundation slab.

(6) Compare the above approximate weights of pier and foundation slab with the weights computed from the dimensions obtained, and if the difference is sufficient recalculate the dimensions, using the more accurate weights.

Bank of Hamilton, Winnipeg

Operations are well under way on the foundation work of the new Bank of Hamilton building at the corner of Main Street and McDermott Avenue., Winnipeg. Twenty-eight reinforced concrete caissons were sunk to bed rock beneath the old bank before it was torn down. The Foundation Company, of Montreal and Winnipeg, Mr. J. Q. Rankin, superintendent, are the contractors for building the foundations of the new bank and also for removing the old brick building. The foundations will be sufficiently strong for a ten-storey building, the caissons being 4 feet to 5 feet in diameter. J. D. Atchison, of Winnipeg, is the architect for the new building, which is to cost approximately $400,000.

Strength of Lateral Bonds in Brick Pavements

Mishaps often teach more about the strength of materials than could be learned by years of ordinary use. This fact is demonstrated by an unusual accident to a stretch of brick highway in Wayne County, Ohio. The accident, which occurred this spring, was on one of the newer brick highways and will be worth a portion of the cost of repairing in demonstrating the degree of solidity in lateral bonds that can be had in

A severe test on the strength of lateral bonds in grouted brick pavement.

grouted brick road surfaces when all the details of good construction have been properly complied with.

The accident was a washout on a portion of brick roadway a short distance west of the city of Wooster, the county seat of Wayne, Ohio, where the road skirts a small stream. Following the spring storms, the waters of the creek overflowed the road for some distance for many hours and the swift current gouged away the embankment supporting the road for several hundred feet. For a distance of 60 feet the concrete base of the pavement was undermined and fell away, leaving the brick surface supporting its own weight by its lateral bond only. It is a remarkable fact that the base, a homogeneous layer, should fall away, while the brick course, consisting of a large number of units, should be left undisturbed. More remarkable still was the fact that the brick pavement was able to support a very considerable weight besides its own dead weight, as shown in the figure. The under side of the pavement was bared for 60 feet, with a maximum width of 6 feet, and a good-sized automobile with passengers was able to rest on the edge of the pavement without disturbing it. It was also subjected to a very severe test when boulders for refilling the cut were dumped on it and rolled over the edge. That it stood these tests, argues well for brick pavement. The road will be reconstructed up to the pavement, reversing the customary order of construction.

The Roman Catholic School Commissioners, Montreal, have awarded the contract for a school on Robin Street to Mr. L. Beaudry, at a cost of $136,000 if Queenston stone is used and $3,000 less if Montreal stone is used. Seventeen tenders were received.

Commercial Use of Blast Furnace Slag as a Constructional Material

By E. C. Brown*

BLAST furnace slag has already found its way into an extensive field of industrial usefulness, principally, of course, as construction material. Granulated slag, that is, hard slag ground down to a finer and more granular substance resembling in appearance coarse sand, is used as a material in cement manufacture, as a cushion under brick and block pavements, as a filter material in certain chemical recovery processes, as a fine aggregate in concrete, etc. Hard slag, crushed and screened to size, is used for railroad ballast, for road macadam and paving foundations, as a concrete aggregate, as a filter material in sewage disposal work, as a material in fireproof construction, etc.

Perhaps the most extensive use of commercial hard slag to-day is in road improvement work, in which it has given most satisfactory results. This is so whether in plain water-bound macadam, or in combination with tars, asphalts or other special binders. Several of these roads have been in service from two to five years and are wearing well.

As an aggregate in concrete for all general purposes slag has been thoroughly tested and is far beyond the experimental stages. It has gone into all kinds of buildings, walls, bridge work, light reinforced structures as fence posts and telegraph poles, floors, roof slabs, and in fact into practically everything for which concrete of any kind is suitable. In not a few classes of construction it is especially well adapted because of its relative lightness, good bonding qualities and perfect fire resisting nature.

Physical Properties

Average commercial blast furnace slag has a specific gravity of about 2:62; limestone averages 2:60; granite, 2:68; and trap rock, 2:96. Slag is of a grayish color, breaks with decided angularity, is somewhat porous, and weighs commercially approximately 2,000 lbs. per cubic yard. Of these qualities, perhaps the most important, or at least the most conspicuous, is its porosity, which may be more properly characterized as cellular construction. This accounts for its relative light weight, both in the natural fragment and in combination, as, for instance, in concrete.

At this point perhaps we may as well refer to the weight of some of the forms of blast furnace slag we have been considering:

Crushed and sized bank slag, as ordinarily produced and shipped, weighs 1,900 lbs. to 2,100 lbs. per cubic yard, probably 2,000 lbs. is very near the average.

Granulated slag varies greatly, probably as low as 800 lbs. or 900 lbs. to as high as 1,500 lbs. to 1,600 lbs. average, say, 1,300 lbs.—both fineness and moisture greatly affecting the weight.

It might be interesting to note some of the relations by weight between the slags we have been considering, the raw materials and the metal product. Under average conditions, the weight of slag from the blast furnace is about fifty per cent. of that of the metal produced. This is, however, subject to considerable variation. It may, under certain furnace burdens, be nearly as low as forty per cent. or again, as high as sixty per cent., although that resulting from the production of ferro manganese may even considerably exceed one hundred per cent. Therefore, given the tonnage of iron produced at a plant or in a district, we have at once practically learned the amount (in tons) of blast furnace slag.

The amount of slag to the ton of metal in the steel making or iron refining processes is much less, and also much more variable than that from the blast furnace. It averages rather less than ten per cent. by weight. To roughly complete quantitative analysis, we might add that all the other waste and refuse material would perhaps amount to about twenty per cent. From this we may say roughly, that from a fairly complete modern plant producing, say, one million tons of iron, which it converts into steel, and then rolls into finished or semi-finished products, there is turned out about 800,000 tons of slag and refuse waste material. The metal and this waste are all the solid or non- volatile matter left of the three and a half million tons of raw materials, ore, coke and limestone, used in the original smelting operation.

But little commercial or industrial use has thus far been made of either the open hearth or converter slags as compared with the better known and more abundant blast furnace slag.

Open hearth slag has been ground and used in agriculture with success as a soil corrective, giving higher and quicker results than lime applied in other and more usual forms.

Slag Concrete Tests and Practice

Prior to the year 1908 occasional uses of slag had been made in concrete work, notably machine slag in fireproofing, etc., but during that year there began a series of somewhat elaborate experiments, which involved the manufacture of about eight hundred concrete specimens in the form of 12 in. by 16 in. cylinders, and which continued over a period of two years. These experiments were made for comparative purposes and included specimens of stone and gravel, as well as slag concrete. The tests indicated generally that slag concrete was fully equal to either of the others, and in many instances it proved superior to them.

The results of these experiments were published during the year 1911 in pamphlet form under the title "Furnace Slags in Concrete." The tests had been undertaken at their inception to determine for our own guidance in our construction work, the desirability, or at least admissibility, of slag for concrete purposes. The results seemed sufficiently conclusive to justify the printing of the booklet, not only to furnish information to our own engineers, but also to give some publicity to the facts.

At the present time there is to be undertaken a somewhat more extensive similar series of experiments, in which slags, stones and other materials from rather widely separated sources, are to be tested in concrete.

For several years now at most of our plants we have used slag almost exclusively in our concrete work, and have also sold large quantities for such use. We have yet to learn of a case where unsatisfactory results

*Before the Engineers' Society of Western Pennsylvania.

followed, or any troubles due to the use of the slag developed.

Of all the uses thus far found for blast furnace slag, there is none to which it is so well adapted as its use in concrete. In its texture and physical properties, even in its substance itself, it is so similar to the cement which binds the thousands of particles into a dense and homogeneous mass, that it is almost, if not quite, the ideal material.

A number of things, no doubt, have combined to retard its use; good gravel in abundance, fair stone not too far distant, conservatism of engineers, and sometimes even prejudice against a so-called waste or by-product.

Extension to the Montreal Harbor Commissioners' Elevators

The growing importance of Montreal as a grain port has necessitated from time to time the extension of the elevator accommodation. About 13 years ago the first steel elevator of the Harbor Commissioners was erected; in 1914 an extension to the east and north was completed, and there has just been opened an addition to the west. These additions are constructed of concrete, and each have a capacity of 1½ million bushels, making, with the original capacity of one million bushels, a total of four millions. Besides this, the commissioners constructed in 1911-12 a new elevator, No. 2, of concrete, with a capacity of 2,600,000 bushels.

The extension to the west is, like the earlier one, fire proof, no wood being used. It is 194 x 127 feet, and stands 220 feet above the base of the rails. The foundations consist of over 2,000 reinforced pre-moulded concrete piles, driven. The structure is known as an up-house elevator, the two railroad tracks running through the first storey. The 114 bins, with hopper bottoms, are of reinforced concrete, while the cupola is of structural steel with reinforced concrete floors and roof, the outside covering being of galvanized corrugated steel.

In order to erect the addition it was necessary to remove to another site offices belonging to the Commissioners—the contract being let to the Foundation Company, Limited. It was also found necessary to divert the Elgin Basin sewer.

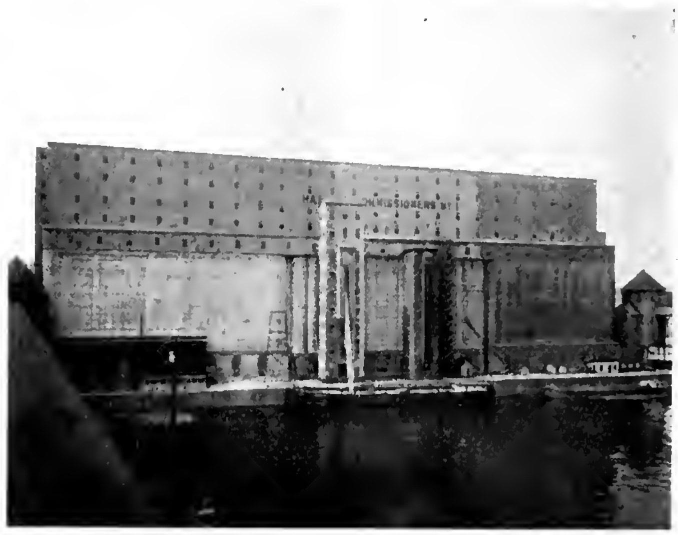
Excavation for the extension was started in March, 1915, pile driving was commenced in May of the same year and completed by the last week of September following. By the 30th of the same month the concrete structure was built as high as the bottom of the bins, and before the end of October the work was up to the top of the bins. This was a very expeditious piece of building. The erection of the steel cupola was started in October and completed in December. During January to May, the equipment was installed, the extension being opened on the 15th of the latter month. Just over 15,000 cubic yards of concrete were poured in two months, and average of 10 cars of stone being received daily during that period. Over 400 tons of reinforcing was utilized.

The grain is received from cars by four steel legs, each of an elevating capacity of 15,000 bushels per hour. The legs receive from the railroad cars running through the first storey. Each leg is provided with a track hopper on each side of the two tracks. These hoppers are so arranged with gates that the grain from either may be elevated as desired. Thus when a carload of grain is being elevated from one side of the leg another car is being unloaded on the opposite side, the gate from the hopper to the leg on the latter being closed. The receiving legs elevate the grain to the top storey, where each leg deposits it into a garner with a capacity of approximately 1,600 bushels. Beneath the garner a 1,600 bushel scale hopper is installed; the receiving scale hopper discharges on to transfer conveyor belts in the cupola, the conveyors leading to the new storage and to the spouts connected with adjacent bins.

The elevator legs are used for shipping grain to the present conveyor system, and grain may be discharged from the shipping bins into the revised arrangement of the shipping conveyor system, by which the shipping belts are carried beneath the new shipping bins, making the entire elevator a homogeneous shipping house.

Four car loading spouts are installed, each receiving from the receiving scales, so that grain may be loaded at one draft. Fourteen of the new bins can be used for sacking purposes.

All the machinery is electrically driven. Electric signals are provided, together with telephones, allowing of rapid communication throughout the entire system. These signals and telephones are also installed in No. 2 elevator and the shipping conveyors.



194 x 127 ft. extension to the elevators of the Montreal Harbor Commission.

The work was carried out for the Montreal Harbor Commissioners. The plans were drawn and the construction supervised by the John S. Metcalf Company, Limited, Montreal, under the direction of Mr. F. W. Cowie, the chief engineer of the Commissioners. The general contract for the superstructure was executed by the Geo. A. Fuller Company, Limited, Montreal, the piling work being done by the P. Lyall & Sons Construction Company, Limited, Montreal. The steel was supplied by the Dominion Bridge Company, and the scales and machinery by Canadian Fairbanks Morse, Limited, Montreal. Mr. P. Lahee was the sub-contractor for the electrical work.

The Union Natural Gas Company of Canada, Chatham, Ont., are constructing forty miles of new ten-inch pipe line to replace a portion of the present eight-inch line to Sarnia. The pipe for this line is being supplied by the Page-Hersey Iron, Tube & Lead Company, of Welland, Ont., and already a considerable portion of the material is on the ground. The actual work of construction will be commenced about the first of June and will be carried through with the company's own organization.

Letters to the Editor

Chicago, May 25th, 1916.

Editor Contract Record:

We were interested to note in your issue of May 3rd, on page 440, a statement relative to the world's highest reinforced concrete tank. It occurs to us that in the interest of your subscribers, and, more particularly, your advertisers, you would use care in your censorship of the articles which appear in your magazine.

The statement of the Blaw Steel Construction Company of Pittsburgh is unfair, and likely to give a decidedly wrong impression of the elevated steel tank which is a product of our manufacture.

The article states that the cost of the steel tower and tank would be less but the life would be short and the repairs, painting, etc., would cause more expense than a concrete tank. As a matter of fact the records of reinforced concrete standpipes show conclusively that while these structures in theory are very excellent things for the storage of water, their actual performance has been very poor, the majority of concrete tanks causing considerable trouble from leakage, and enormous expenditures for maintenance and repairs.

It is not true that the life of the steel tank is relatively short. We have been manufacturing these structures for the past 27 years and so far as we know every one of our tanks are in active service to-day. There is no expense for repairs and the only cost to which the owner may be put is a coat of paint about once in five or six years.

The maintenance of the concrete tank in the way of water-proofing and refinishing of the outside of the structure necessitated by spalling off of concrete is high in comparison to the slight maintenance and cost of the steel tank. Furthermore, in many cases the leakage in concrete tanks has been so serious as to necessitate their complete abandonment. In fact we have built a number of steel tanks to replace concrete structures which have been failures.

We trust that in the interest of your subscribers you will bring out the truth of this matter. In substantiation of our statements we would refer you to the June, 1915, quarterly of the proceedings of the New England Water Works Association.

Yours very truly,
Chicago Bridge & Iron Works,
By F. L. Cook, Sales Engineer.

New Books

Concrete Construction for Rural Communities—by Roy A. Seaton, M.S., Professor of Applied Mechanics and Machine Design and Superintendent of Construction, Kansas State Agricultural College; McGraw-Hill Book Company, Inc., publishers; price $2.00 net. This is a text book treating the essential features of concrete construction in a thorough, yet simple, manner. The author has endeavored to make it suitable for use as a text in a brief course of concrete construction for agricultural or other students in colleges, when accompanied by laboratory exercises and field construction and at the same time has striven to make it valuable to others who have occasion to use concrete. The field covered by the book is illustrated in the following headings: Part 1, Materials, three chapters; Part 2, Plain Concrete, three chapters; Part 3, Reinforced Concrete, two chapters; Part 4, Miscellaneous Matter, four chapters; Part 5, Typical Applications of Concrete, three chapters. Size 5½ x 8 in.; 200 pages; bound in red cloth; well illustrated.

The work of concreting for the Toronto-Hamilton highway was recently commenced in the Port Credit district. Operations are also under way at Burlington.

Obituary

Mr. John Price, who for over forty years has been the proprietor of a large brick manufacturing company in Toronto, bearing his name, died recently at his home in that city. He was 71 years of age. Mr. Price was born in England and came out to Canada as a young man.

The death occurred recently of Mr. David Alexander, of the well-known contracting firm of Alexander & Campbell, at his home at Ottawa. Mr. Alexander started in the contracting business with Mr. Wm. Campbell 15 years ago, and during that time the partners have built up a large business.

Mr. Simpson Fleming, one of Ottawa's oldest and best known citizens, who superintended the erection of the first water mains laid in the capital, died recently at the age of 89 years. He came to Canada from Ireland as a young man and has since lived in the vicinity of Ottawa, where for thirty years he was in the city's employ. For a time he was inspector of installation for the Arnprior waterworks.

Mainly Constructional

East and West—From Coast to Coast

The Milton Pressed Brick Company, Limited, Toronto, have taken out a charter.

The Brotherhood of the Stationary Engineers at Ottawa have been granted a charter.

The Grandview Sheet Metal Works, Limited, has been incorporated with a capital of $10,000, head office at Vancouver.

The new C. P. R. depot at North Toronto is nearing completion. It is expected that the contractors will hand it over to the company in a few days.

A town planning campaign committee has been organized at Halifax, N.S. Mr. Thomas Adams, the town planning expert, was present at the opening and explained the lines upon which he would deem it best to work in that city.

The Port Hope File Manufacturing Company, Limited, has been incorporated with a capital of $40,000; head office, Port Hope, Ont. The company will carry on the business of iron founders and workers and file markers and cutters.

Work on the enlarging of the plant of the Canada Foundries & Forgings Company at Welland has been going on for some time, and it is now announced that operations have been commenced with an increased capacity of 33 per cent.

Building operations in Halifax, N.S., have fallen off somewhat this year. The total number of permits issued during April represented a value of $95,924, as compared with $125,890 in 1915, and the total for the year to date is $141,716, while for the same period last year it was $246,278.

The United States reclamation project ditch across the boundary south of Cardston, Alta., which was recently completed, is reported as now requiring from 15 to 30 miles of cement lining, calling for 500 car loads of cement. The order is to be delivered at Cardston and hauled across the line from that point.

It is reported that a Windsor syndicate is being formed to build a thousand houses to accommodate the surplus population of Detroit which cannot find housing accommodation. The houses will be built in a section of the city for which increased transportation facilities are now being planned by the City Council.

The contract for the buff stone for the new Union

Depot, Toronto, has been awarded to George Oakley of Toronto, at a price of $300,000, representing about fifteen thousand tons of cut stone. This stone will be quarried in Illinois, and in order to avoid duty, sent to Canada in the rough state and worked up here.

The beginning of a broader and more extensive system of road repair and rebuilding is evidenced in North Monaghan, Ont., this spring. A new road drag has recently been put into operation on No. 6 division, in order to facilitate the work. The gravel and crushed stone will be supplied from the big C. P. R. pit in that district.

The Contractors Equipment Company, Limited, has been granted letters patent of incorporation to carry on the business of dealers in contractors' equipment and supplies generally, and also the business of dredging, excavating and steam shovel work of all kinds. The capital of the company is $40,000, and its head office is in Toronto.

For the year ended March 31st last the earnings of P. Lyall & Sons Construction Company, Limited, Montreal, totalled $234,644, an increase of $14,967. After providing for bond interest, sinking fund, and preferred dividend, $32,362 is carried forward. The sum of $376,194 was spent for machinery and buildings for manufacturing munitions.

A meeting of the City Council of Woodstock, Ont., was held recently to decide upon the best type of permanent paving for the streets of the city. A large number of ratepayers were present and the debate occupied a long session. No decision was reached, however, the aldermen considering another tour of inspection necessary before deciding on the question.

At the annual meeting of the National Brick Company of Laprairie, Que., a net deficit of $63,170 was reported for the year ending February 29. The president, however, stated that since March 1 considerable improvement had been noted in the demand for bricks and the company had been able to close contracts so far this spring for about ten million bricks at fair prices.

British Columbia's first steel, ocean-going, cargo steamer will be built at the Wallace Shipyards, North Vancouver, under a contract recently placed by the firm of Dingwall, Cotts & Company, through their Vancouver manager, Mr. John Eadie. The boat will be 315 feet long with 45-foot beam. She will have a carrying capacity of 5,000 tons and a speed of nine and a half knots.

The two most important Montreal building schemes for Montreal this season are for theatres. One is to be built on St. Catherine Street West by the Fleischmann Construction Company, New York, for Marcus Loew, of New York. It will seat 3,750 people. The other is for the United Theatres Limited and Keith interests, the plans for which are being drawn up by Mr. D. J. Spence, architect, Montreal.

The contract the Peter Lyall & Sons Construction Company received in connection with the reconstruction of the Parliament Buildings at Ottawa covers the building of the main walls and certain other work, the total estimate of which is around two million dollars. The company is to be paid 8 per cent. on the actual cost of the operation. For the inside of the buildings, such as the construction of the chambers, plumbing, heating, painting and decoration, competitive bids will be asked.

A scheme is on foot to construct an international highway along the boundary line between the United States and Canada, to be named the "Peace Highway," in celebration of the 100 years without war between the two countries. The question was first taken up by the council of Matsqui, B.C., and the commissioners of Whatcom County, Wash., and it is now proposed to bring it before the Dominion Government and the United States Congress. The Whatcom County commissioners have already outlined a highway from the salt waters of Blaine and White Rock to the mountains near Sumas and Huntingdon, as the first unit of what eventually it is hoped will be a paved highway from the Pacific to the Atlantic along the boundary, connected with the Pacific Highway from Blaine to California and the Interprovincial highway from Vancouver to Chilliwack.

The council of St. John, N.B., recently discussed the question of replacing the old cement pipe, which runs through what is known as the "dry lake," with new water mains to be carried around the lake on dry land, a scheme which will involve the expenditure of some $40,000. Tenders are to be called for piping, cast iron and steel, in order to make a comparison of prices. The trouble with the cement pipe is the difficulty in making repairs owing to the nature of the ground through which it runs.

A meeting of the Council of Saskatchewan Architects was held recently at Regina for the purpose of receiving applications for registration. One of the items of business was the appointment of a new secretary to take the place of Mr. Knight, who resigned, having joined the 195th Battalion. Mr. Lindley H. Bennet, architect for Regina public schools, was appointed to fill the vacancy. Lieut. Thompson resigned as secretary of the examining board and Mr. Cooper, of Saskatoon, is taking his place.

The town of The Pas, Man., is inviting tenders for sewage lift pumps with the necessary motors, for the purpose of pumping raw sewage and surface drainage from a chamber with a bottom elevation at 819 feet. Two single stage vertical submerged type centrifugal pumps with a speed of not more than 680 r.p.m. are required, one capable of delivering 500 Imperial gallons and the other of 1,000 Imperial gallons per minute. The sewerage is discharged into the main sewer and then into the river; during a portion of the year sewage can be discharged by gravity, but other months the water level in the river changes, thus increasing the head of the water over the sewer outlet to such an extent that the gravity discharge ceases, and the lift pumps are then required. The elevation of the pumps will be 827 feet. The two vertical type induction motors are to be 3 phase, 60 cycle, 220 volts, with impregnated winding, and with automatic float type controlling devices. The plans also provide for three 5-kw. single phase, 2200 volt primary 110 and 220 secondary volt, oil-cooled transformers or one 3 phase 15 kw. 220 volt secondary with primary fuse cut outs, hanger irons and oil. Messrs. Murphy and Underwood, Saskatoon, are the consulting engineers.

The Saskatchewan Co-operative Elevator Company propose to erect a terminal elevator at Port Arthur, Sask., to be completed for the harvesting of the 1917 crop. It is to be entirely built on a water site, running out from the shore a distance of about 1,400 feet to the public harbor and having a frontage on the harbor of 500 feet. The piles to be used in the foundation, which will number probably 8,000, owing to favorable conditions will not require to be more than about 25 feet in length. A contract for driving them is to be let shortly. The plant will be of fireproof construction, principally reinforced concrete, and the first unit of storage tanks will have a capacity of two million bushels, while provision has been made for the addition of other units to bring the storage up to eight million bushels at a later date. The workhouse, which will have 106 bins with a capacity of 500,000 bushels, will be of the "rapid handling" type. There will be sixteen receiving pits arranged in rows of four into which thirty-two cars of grain per hour can be unloaded. The consulting engineer whose services the company have secured to design and supervise the construction of the new terminal is Mr. C. D. Howe, who has already established an office at Regina, where a staff is at work preparing drawings and specifications. It is hoped that the contract for the entire work will be signed by September 1 next.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Edmonton, Alta.
The City Council propose to lay plank sidewalks, at an approximate cost of $25,000. Engineer, A. Haddow.

Lindsay, Ont.
The Town Council contemplate the construction of about 8,200 square yards of asphaltic concrete pavement with curbs, gutters, manholes, etc. Approximate cost, $20,000.

Ste. Cecile de Whitton, Que.
The Municipal Council propose to construct waterworks at an approximate cost of $5,000. No tenders will be called. Secretary, J. G. Beaudoin.

CONTRACTS AWARDED

Assiniboia, Man.
The Rural Municipality have let the contract for construction of watermain to T. Jackson & Sons, 370 Colony Street, Winnipeg, at $3,400, and for sewers to the Hurst Engineering & Construction Company, 406 Ashdown Building, Winnipeg, at $15,834.

Moncton, N.B.
The City Council have awarded the contract for construction of pavement on Main Street to the Warren Bituminous Paving Company of Ontario, Ltd., McKinnon Building, Toronto, at $51,968.

Ottawa, Ont.
The contract for construction of tarvia pavement on Russell Avenue has been let by the City Council to R. A. Morrison, care of the Engineer, F. C. Askwith. Approximate cost, $9,000.

Raleigh Township, Ont.
The Town Council have awarded the contract for drain improvements to J. E. Doyle, Cross Street, Chatham, at $4,000.

Railroads, Bridges and Wharves

Dundas, Ont.
Tenders on the construction of a concrete dam 80 feet long will be received until June 17th by the Chairman of the Utilities Commission. Engineer, E. H. Darling, 601 Spectator Building, Hamilton.

London, Ont.
City Engineer H. A. Brazier is about to prepare plans for the construction of a concrete breakwater, estimated to cost $15,000.

Montreal, Que.
L. G. Mouchel & Partners, Mail Building, Toronto, are preparing designs and specifications for the reinforcement of the LaSalle Bridge over the Lachine Canal for the City Council. Estimated cost, $94,000. Hennebique system.

Saskatoon, Sask.
The City Council propose to construct about 1,200 feet of double track, at an approximate cost of $8,600. Engineer, G. D. Archibald.

Windsor, Ont.
The Detroit & Windsor Ferry Company propose to construct docks at the foot of Ouellette and Ferry Streets, and have submitted plans to the Canadian Department of Fisheries and Marine. Approximate cost, $150,000.

CONTRACTS AWARDED

Ottawa, Ont.
The City Council have awarded the contract for superstructure of the Pretoria Avenue bridge to the Dominion Bridge Company, Sparks Street, at $84,000.

Public Buildings, Churches and Schools

Berlin, Ont.
Cowan Brothers, Victoria Street, are preparing plans of a Sunday School for St. Peter's Church, Queen Street N., and will call for tenders shortly. Brick construction. Approximate cost, $20,000.

Creemore, Ont.
P. C. Palin, Collingwood, Ont., has prepared plans of a school, estimated to cost $18,000. The existing building will be razed and all suitable material reused. Brick construction.

Glenside, Sask.
Tenders on the erection of a church are being received by J. B. Stoehr. Estimated cost, $4,000.

Kingston, Ont.
Tenders will be received until June 14th for the erection of a riding school at Royal Military College for the Department of Public Works, Ottawa. Plans and specifications at office of the Architects, Power & Son, Kingston, at Postal Station F., Yonge Street, Toronto, and at the Department. Approximate cost, $18,000.

London, Ont.
The time for receiving tenders on the erection of the proposed Technical School has been extended to June 12th. Architects, Watt & Blackwell, Bank of Toronto Building.

Netherhill, Sask.
The Trustees of School District No. 2659 have been empowered to borrow $3,000 for the erection of an addition to the school. Treasurer, John Craig, Netherhill.

Port Colborne, Ont.
The contract for the erection of St. James Church has been cancelled and new plans are being prepared by C. M. Borter, Niagara Falls. Approximate cost, $24,000.

Sudbury, Ont.
The Public School Board are having plans prepared for a school to cost about $25,000. Architect, F. L. Morgan, Wilson-Greenwood Block. Brick and concrete construction.

Toronto, Ont.
Burke, Horwood & White, Ryrie Building, have prepared plans of a gymnasium and club building to be erected on University Avenue for the Somers School of Physical Training. Approximate cost, $85,000. Tenders have been closed.

Funds are now being raised for the addition of a wing to the Roman Catholic Seminary on Kingston Road. Brick and steel construction.

CONTRACTS AWARDED

Calgary, Alta.
The general contract for the erection of a school has been let by the Roman Catholic School Board to Rodger Bros. Estimated cost, $14,000.

Howe's Lake, N.B.
The following contracts have been awarded in connection with the erection of an isolation hospital:—carpentry and masonry, G. Lawson, Glen Falls, at $8,960; plumbing and heating, W. E. Emerson, West St. John, $2,994; painting, J. H. Pullen, 16 Horsefield Street.

Montreal, Que.
The sub-contract for roofing and plumbing in connection with the erection of a church for the Parish of St Pierre Claver has been let to G. Champagne, 78a Inspector Street.

Ottawa, Ont.
Work has been started on an addition to St. Patrick's Asylum, Gloucester St. The general contract has been let to Felix McCullough, Waller Street; steel work to the Dominion Bridge Company, Sparks Street, and plumbing to Thomas Watters, 288 Booth Street. Brick and concrete construction. Approximate cost, $4,500.

Sarnia, Ont.
The Separate School Board have awarded the contract for the erection of a school to James Shanks, 272 Wellington Street, and have cancelled the previous contract. Approximate cost, $16,000.

Sombra Township, Ont.
The Trustees of School Section No. 5 have let the general contract for the erection of a brick school to Charles Hubbell, Thamesville, Ont. Approximate cost, $4,250.

St. Lin de Laurentides, Que.
The Roman Catholic School Board have let the general contract for the erec-

tion of a college to Gauthier & Ouellette, care of C. A. Reeves, 709 Power Building, Montreal.

St. Pierre, Que.
The School Board have awarded the contract for the construction of a frame school to Z. Cloutier. Approximate cost, $6,200.

Windsor, Ont.
The general contract for the erection of an addition to the Collegiate Institute has been awarded to Wells & Gray, Limited. Manning House Block. Approximate cost, $150,000.

Business Buildings and Industrial Plants

Brantford, Ont.
Tenders will be received until June 9th for the erection of a factory for the Royal Paper Box Company. Architect, J. Evans, 30 Water Street N., Galt. Approximate cost, $12,000. Brick and concrete construction.

Gananoque, Ont.
F. Delaney contemplates remodelling premises on King Street for an opera house, and is receiving prices on metallic ceilings, hard brick, beaver board, electric fixtures and chairs. Approximate cost, $4,000.

Hamilton, Ont.
The W. T. Rawleigh Company, Freeport, Ill., will receive tenders until June 12th for the erection of a factory. Architects, McPhie, Kelly & Darling, Bank of Hamilton Building. Reinforced concrete construction.

Levis, Que.
Tenders on the construction of a station, viaduct and train shed for the Intercolonial Railway will be received until June 17th by J. W. Pugsley, Secretary Department of Railways and Canals, Ottawa. Plans and specifications at office of the Chief Engineer of the Department, with Chief Engineer, Moncton, N. B., with Resident Engineer, Levis, and the Architects, Ross & McDonald, 1 Belmont Street, Montreal.

London, Ont.
Preliminary plans for the proposed hydro office will be prepared by General Manager Buchanan, and an Architect will be appointed to supervise the architectural features.

Montreal, Que.
J. S. Jacobs and William Bell, Jacobs Building, are about to start work on the erection of a picture theatre on Sherbrooke Street, estimated to cost $50,000. Architect, D. J. Crighton, 282 St. Catherine Street W. Stone, plastic brick and steel construction.

Ottawa, Ont.
Peter Lyall & Sons Construction Company, Limited, are building a workshop on Sussex Street, estimated to cost $35,000. Frame construction.

Peterboro, Ont.
William Langford, Water Street, is preparing plans of a factory for the Bonner-Worth Company, McDonnell and Cambridge Streets. The project is very indefinite at present. Approximate cost, $10,000.

Russell, Man.
The Union Bank of Canada propose to rebuild their premises on Main Street, and have appointed as Architects Jordon & Over, 47 Canada Life Building, Winnipeg. Approximate cost, $8,000.

Saguenay River, Que.
The Du Pont Powder Company, Wilmington, Del., have secured properties and water rights preparatory to the construction of a plant for the manufacture of liquid air. Approximate cost, $10,000,000.

Toronto, Ont.
C. W. Spink, 170 Lake Front, has commenced the erection of a refreshment pavillion, estimated to cost $3,000. Frame construction.

Plans have been drawn for a garage to be built on Mill Street by William Davies & Company, 521 Front Street E. Brick construction. Estimated cost, $3,500.

Plans have been prepared for a warehouse to be built on Cawthra Avenue for the Campbell Flour Mills Company, Limited. Reinforced concrete construction. Estimated cost, $20,000. Engineers, J. H. Fromanhauser Company, Limited, 604 Temple Building.

The Harris Abattoir Company, Ltd., Union Stock Yards, have had plans prepared for an addition to their premises, estimated to cost $50,000. Brick construction.

The Conger Lehigh Coal Company, 95 Bay Street, have commenced the construction of a coal elevator and pockets, estimated to cost $10,000. Frame construction.

Vancouver, B.C.
Tenders on the construction of a railway station at False Creek for the Canadian Northern Railway will be received until noon, June 20th, by the General Manager, M. H. McLeod, Vancouver. Architects, Pratt & Ross, 1011 Electric Railway Chambers, Winnipeg. Approximate cost, $1,000,000.

Weston, Ont.
Prack & Perrine, 808 Lumsden Building, Toronto, are preparing plans of a factory for T. A. Russell, King and Duncan Streets, Toronto. Steel and brick construction. Estimated cost, $150,000.

CONTRACTS AWARDED

Brantford, Ont.
The Ham & Nott Company, Limited, 81 Elgin Street, have commenced the rebuilding of their premises, and have let the roofing to the Brown-Jarvis Roofing Company, 9 George Street. Estimated cost, $3,000.

Halifax, N.S.
The contract for plumbing required in alterations to a theatre for the Academy of Music has been let to G. A. Perrier, 35 Granville Street, and electrical work to Farquhar Brothers, Barrington Street.

Hamilton, Ont.
The general, masonry and carpentry contracts for the erection of an addition to the premises of the Canadian Ste.l & Wire Company have been let to Woodhall & Sinclair, 105 Sanford Avenue S. Approximate cost, $4,000. Mill construction.

The general, masonry, carpentry and roofing contracts for the erection of a store for W. Dyment, 58 St. Mathews Avenue, have been let to Blake & McDonald, 73 Central Avenue. Brick and stone construction. Estimated cost, $3,000.

The contract for plumbing required in an addition to the factory of the T. Eaton Company has been let to Drake Avery Company, John Street.

The general contract for the erection of a factory for the Mercury Mills Ltd., 80 Park Street N., has been let to W. H. Cooper, Clyde Building. Approximate cost, $125,000.

London, Ont.
The following contracts have been let for alterations to the Bank of Montreal:—carpentry, Tambling & Jones, Hamilton Road; painting, Colerick Brothers, 212 Dundas Street; plumbing, Noble & Rich, 237 Queens Avenue; electrical work, Benson & Wilcox, 264 Dundas Street. Approximate cost, $6,000.

Montreal, Que.
The general contract for the erection of an office building for Lymburner Ltd., 515 Commissioners Street, has been let to the Atlas Construction Company, Limited, 37 Belmont Street. Sub-tenders will be called for. Approximate cost, $8,000.

In connection with the addition to the premises of the Canadian Consolidated Rubber Company, the roofing has been let to G. W. Reed, 37 St. Antoine Street. Heating, plumbing and electrical work by owners.

The general contract for the erection of a store and residence for B. Zeolis, 350 City Hall Avenue, has been let to Church Ross Company, 40 Hospital St. Approximate cost, $6,900.

The general contract for the erection of a factory and shed for the Dominion Oil Company, 1192 St. Catherine Street E., has been awarded to Reid, McGregor & Reid, 511 St. Catherine Street E. Approximate cost, $10,000.

New Toronto, Ont.
The contract for steel required in the erection of a factory for the Goodyear Tire & Rubber Company, 152 Simcoe Street, Toronto, has been let to McGregor & McIntyre, 1139 Shaw Street, Toronto.

Ottawa, Ont.
The contract for painting required in the erection of a building for Jackson Booth & Syndicate, Metcalfe Street, has been awarded to G. T. Green, 796 Bank Street, and plastering to Frank Hunt, 115 Arlington Avenue.

The contract for an addition to a restaurant on Queen Street for Sir G. Perley has been let to H. P. Beck, 126 Sparks Street. Brick construction. Approximate cost, $3,000.

Peterboro, Ont.
The contract for heating in connection with additions to the premises of the Bonner-Worth Company has been awarded to George Brenton, Queen and Hunter Streets.

Preston, Ont.
In connection with the additions being built to the factory of the Solid Leather Shoe Company, the contract for

brick work has been awarded to F. Schroeder. Carpentry by general contractor.

Work has been started on the erection of a business block on Argyle Street for F. G. Wurster. The brick work has been let to Wirsching Brothers, and carpentry to Norman Hipel. Approximate cost, $3,000.

St. Catharines, Ont.
In connection with the factory in course of erection for the Dominion Food Company, the contract for roofing has been let to the general contractors, Newman Brothers.

Toronto, Ont.
In connection with the erection of the new Union Station, the cut stone contractors, George Oakley & Son, have let the contract for delivery of stone to the Indiana Quarries Ltd., C. T. Penn, Local Representative. Contract involves about 160,000 cubic feet.

J. D. Young & Son, 835 College Street, are receiving tenders on painting required in the erection of a workshop for A. R. Clarke & Company. Approximate cost of building, $10,000.

The general contract for the erection of an office building on Bay Street for the Trusts & Guarantee Company, Ltd., has been let to William Cowlin & Son of Canada, Ltd., Mail Building, and the plumbing, heating, ventilating and wiring contracts to Bennett & Wright, 78 Queen Street E. Approximate cost, $200,000.

Vancouver, B.C.
The following contracts have been let in connection with the erection of the proposed station at False Creek:—steel, Canadian Northwest Steel Company; lumber, Hanbury & Company, Vancouver Lumber Company, False Creek Lumber Company, and Small & Bucklin; stonework, MacDonald & Wilson; brick, Sidney Island Brick and Tile Company; electrical work, Mundy Rowland Company.

In connection with the addition to the plant of the Begg Motor Company, the contract for roofing and steel metal work has been let to Little & Lee, 682 Seymour Street, and the electrical work to C. H. E. Williams, 509 Richards St. Plastering by day labor.

Windsor, Ont.
Work has been started on the erection of a store and flats for J. Stone, 37 Aylmer Avenue. The general contract has been let to Abbott & Gray, 42 Parent Street. Brick veneer and concrete construction. Approximate cost, $5,500.

A. J. Rattray, Engineer, Stair Building, Toronto, has let the following contracts for the erection of a grand stand: steel, Hepburn & Disher, Van Horne Street, Toronto; concrete, C. W. Cadwell, 261 Ouellett Street; corrugated iron roofing, Windsor Hardware Company, 71 Sandwich Street E.; track building, Orpen Company, Limited, 166 King Street E.; track building, Orpen Company, Ltd., 166 King Street W., Toronto. Approximate cost, $100,000.

Yorkton, Sask.
The contract for masonry required in the erection of a garage for Charles Flik and Mrs. Lindsay has been let to W. Peterson, who may also be awarded the general contract. Brick construction. Approximate cost, $4,000.

Residences

Halifax, N.S.
The Eastern Investment Corporation, Cragg Building, are receiving tenders on heating, plumbing, and electrical work required in connection with residences which they propose to build.

London, Ont.
Watt & Blackwell, Bank of Toronto Building, are preparing plans for an apartment for R. H. McKnight, 296 Queens Avenue. Brich construction. Approximate cost, $10,000.

Plans of a residence are being prepared for A. O. Hunt, 23 Wortley Road, by Watt & Blackwell, Bank of Toronto building. Estimated cost, $4,000. Frame and white brick construction.

London Township, Ont.
Thomas Smibert, R.R. No. 1, Ilderton, Ont., has prepared plans of a residence estimated to cost $3,000, and will let contract shortly. Red pressed brick construction.

Plans of a residence have been prepared by David Leckie, R.R. No. 1, Hyde Park. Red pressed brick consruction. Estimated cost, $3,000.

Montreal, Que.
H. Wilensky, 1900 St. Urbain Street, is considering the erection of six flats at an approximate cost of $5,000, and alterations to a residence estimated to cost $5,000.

H. Brunelle, 122 Prefontaine Street, is having plans prepared for a residence, estimated to cost $5,000. Architects, P. L. W. Dupre & Company, 567 Delorimier Street.

The erection of a residence is contemplated by J. Lecavalier, 74 St. James Street. Approximate cost, $3,000.

John Dominique, 166 Marcil Street, is about to start work on two flats, estimated to cost $6,000. Brick construction.

J. P. Tremblay, 291 Prudhomme Street, is about to commence the erection of two flats, estimated to cost $5,000.

A. Gregoire, 418 Northcliffe Boulevard, is about to start work on the erection of two flats, estimated to cost $4,500.

Niagara Falls, Ont.
John Lamb, 320 Victoria Avenue, has commenced the erection of a residence on Burns Avenue, estimated to cost $1,000. Plumbing, heating and electrical work will be let.

Ernest Scott, Victoria Avenue, has started work on a residence, estimated to cost $4,000, and will let plumbing, heating and electrical work. Brick veneer construction.

A. Smith, Southend Post Office, has commenced the erection of a residence on Roberts Street, and will let plumbing, heating, and electrical work. Approximate cost, $4,000.

The erection of a residence on Cookman Avenue, has been commenced by F. Maland, Cookman Avenue, and A. Smith, Southend Post Office. Heating, plumbing, and electrical work will be let.

Ottawa, Ont.
H. Atkinson, 39 Rosebery Avenue, proposes to build a residence, at an approximate cost of $5,500. Brick veneer construction.

W. F. Mackenzie, 184 Concord Street, is considering the erection of a residence, to cost about $5,000. Brick veneer construction.

The Oakland Land Company have commenced the erection of a residence, and are receiving tenders on masonry, carpentry, roofing, plastering, painting, heating, plumbing, and electrical work. Manager, W. J. Spratt, 307 Sunnyside Avenue. Estimated cost, $5,000.

B. A. Grison, Fentiman Avenue, proposes to build a residence at an approximate cost of $6,000, and has had plans prepared. Tenders are now being received on plastering, painting, heating, plumbing, and electrical work. Stucco construction.

Toronto, Ont.
W. S. Grimshaw, 462 Avenue Road, proposes to build three duplex residences, at an approximate cost of $18,000, and has had plans prepared by P. H. Finney, 79 Adelaide Street E. Brick construction.

Charles Hough, 905 Broadview Avenue, has commenced the erection of a residence, estimated to cost $4,500. Smaller trades will be let. Brick construction.

Moore & Gemmell, 14 Kenwood Street, have commenced the erection of a pair of residences, estimated to cost $4,200, and will let smaller trades. Brick construction.

G. Nicholson, 6 High Park Gardens, has prepared plans of four residences, which he proposes to build on Boston Avenue. Smaller trades will be let. Brick construction. Estimated cost, $4,000.

A. & A. Grant, 837 Logan Avenue, have commenced the erection of a residence on Playter Boulevard, estimated to cost $3,500. Brick construction. Smaller trades will be let.

George Blackmore, 89 Bernard Avenue, contemplates the erection of a residence, estimated to cost $10,000.

S. Garfunkel, 316 Bathurst Street, has commenced alterations and repairs to five residences, estimated to cost $3,000.

J. T. Moore, 30 Brookmount Street, proposes to build a residence and has had plans prepared by P. H. Finney, 79 Adelaide Street E. Smaller trades will be let. Estimated cost, $3,200.

H. C. Long, 605 Traders Bank Building, is considering the erection of eight residences on Keewatin Avenue, at an approximate cost of $5,000 each. Smaller trades will be let. Brick construction.

The International Land Corporation, 43 King Street W., are building four pairs of residences on Craighurst Street. Brick construction. Approximate cost, $16,000.

E. C. Hurlburt, 44 Castlefield Avenue, has commenced the erection of three bungalows on Briar Hill Road, and will let smaller trades. Brick construction. Approximate cost, $3,000 each.

E. C. Hurlburt, 44 Castlefield Avenue, is building two residences, estimated to cost $5,000 each, and three bungalows at an approximate cost of $3,000 each. Brick construction. Smaller trades will be let.

Work is about to start on the erection

(Continued on page 51)

Tenders and For Sale Department

Department of the Naval Service

Tenders for Hatchery and Dwelling

Sealed tenders addressed to the undersigned and endorsed "Tender for Hatchery and Dwelling" will be received up to 12 o'clock noon on **Tuesday, June 20**, for the Construction of a

Fish Hatchery and Dwelling at Kingsville, Ont.

Forms of tender, specifications and all necessary information may be obtained by application to the undersigned. Plans and specifications will be exhibited at the office of the District Engineer, Public Works Department, Windsor, and the Postmaster, Kingsville, Ont.

Tenders must be accompanied by an accepted cheque payable to the Honourable the Minister of the Naval Service for One Thousand Dollars ($1,000.00). This will be held for forfeit if the party tendering fails to enter into the contract if called upon to do so, or in any way fails to properly fill same.

G. J. DESBARATS,
Deputy Minister of the Naval Service.

Department of the Naval Service,
Ottawa, May 27, 1916.

Unauthorized publication of this advertisement will not be paid for. 23-24

Canadian Government Railways

TENDERS

Sealed tenders, addressed to J. W. Pugsley, Secretary, Department of Railways & Canals, Ottawa, Ont., and marked on the outside, "Tender for Levis Station," will be received up to and including **Saturday, June 17th, 1916**, for the construction and erection of

Viaduct, Station and Train Shed

at Levis, P. Q.

Plans, specifications and blank form of contract may be seen on and after June 1st, at the office of the Chief Engineer, Department of Railways & Canals, Ottawa, Ont., at the office of the Chief Engineer, Moncton, New Brunswick, at the office of the Resident Engineer, Levis, P. Q., and at the office of Ross & McDonald, Architects, Montreal, P. Q.

Contractors who wish to obtain plans and specifications temporarily for their own use may obtain same from Ross & McDonald on depositing with them a certified bank cheque in favor of the Canadian Government Railways for the sum of $50.00, which will be refunded on the return of the plans and specifications to them.

All the conditions of the specifications and contract form must be complied with.

Tenders must be put in on the blank form of tender which may be obtained from any of the offices at which plans are on exhibition.

A security deposit will be required as called for in tender form.

The lowest or any tender not necessarily accepted.

F. P. GUTELIUS, General Manager,
Canadian Government Railways.

Dated at Moncton, N. B.,
May 29th, 1916. 23-23

Tenders for Motor Tractors and Fire Apparatus

Tenders addressed to the undersigned will be received by registered post only, up to noon on **Tuesday, June 20th, 1916**, for the supplying of the following:

3 Motor Combination Hose and Chemical Engines.

1 Motor Tractor for hook and ladder at Ossington Avenue Fire Hall.

1 Motor Truck for delivering supplies and hauling coal for fire engines.

1 Motor Combination Salvage and Chemical Truck.

1 Motor Hook and Ladder Truck.

Specifications of the above can be seen and forms of tender obtained upon application at the office of the Fire Department, Adelaide Street Fire Hall, Toronto. The usual conditions relative to tendering as prescribed by City By-law must be strictly complied with, or the tender will not be entertained. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman Board of Works.

23-23

Board of Education

Sealed tenders, whole or separate, addressed to the Secretary-Treasurer of the Board of Education, will be received until

Thursday, June 15th, 1916,
for

Exterior Painting, Sundry Schools.

Erection of Flag Poles, Sundry Schools.

Oil Burning Apparatus for Steam Boilers at Earl Grey School.

Self-Feeding, Coal Burning Apparatus for Boilers at Queen Alexandra School.

Plumbing and Drain Work, Sundry Schools.

Sale of Old Houses at 115 and 117 Ryerson Avenue

Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto. Each tender must be accompanied with an accepted bank cheque for five per cent. of the amount of tender or its equivalent in cash, applying to said tender only. Sureties for all tenders exceeding four thousand dollars must be furnished by Surety Companies. Tenders must be in the hands of the Secretary-Treasurer, at his office in the City Hall, **not later than 4 o'clock** on the day named, after which no tender will be received. The lowest or any tender will not necessarily be accepted.

MILES VOKES,
Chairman of Property Committee

W. C. WILKINSON,
Secretary-Treasurer.

23-23

Board of Education

Sealed tenders, whole or separate, addressed to the Secretary-Treasurer of the Board of Education, will be received until

Friday, June 16th, 1916
for

Pupils' Special Commercial Desks and Chairs

Teachers' Desks and Chairs

Office Desks, Chairs, Filing Cabinets

Seating for Auditorium, Etc.

for

The New High School of Commerce

Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto. Each tender must be accompanied with an accepted bank cheque for five per cent. of the amount of tender or its equivalent in cash, applying to said tender only. Sureties for all tenders exceeding four thousand dollars must be furnished by Surety Companies. Tenders must be in the hands of the Secretary-Treasurer at his office in the City Hall, **not later than 4.30** o'clock on the day named, after which no tender will be received. The lowest or any tender will not necessarily be accepted.

W. W. HODGSON,
Chairman of Advisory Commercial Committee.

W. C. WILKINSON,
Secretary-Treasurer.

23-23

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Riding School, Royal Military College, Kingston, Ont.," will be received at this office until 4 p.m., on **Wednesday, June 14, 1916**, for the work mentioned.

Plans, specification and forms of contract can be seen and forms of tender obtained at the office of Messrs. Power and Son, Architects, Kingston, Ont. Thos. Hastings, Clerk of Works, Postal Station "F," Toronto, Ont., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, May 30, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—45139. 23-24

Residences

(Continued from page 49)

of a residence on Oriole Road for R. J. Maclennan, Kent Building. Architect, W. B. Galbraith, 22 St. Leonards Avenue. Brick construction. Estimated cost, $6,000.

G. W. Dale, 12 Butternut Street, is about to start work on a residence, estimated to cost $3,000. Smaller trades will be let. Brick construction.

The erection of a residence at an estimated cost of $7,500, is contemplated by W. P. Levack, 519 Roxton Road. Smaller trades will be let. Brick construction.

Work has been started on the erection of a pair of residences for N. J. Craig, 173 Grace Street. Architect, J. H. Stanford, 17 Westmoreland Avenue. Approximate cost, $5,000.

C. Gardiner, 91 Glenholme Avenue, has commenced the erection of a residence on Northcliffe Boulevard, and will let the smaller trades. Brick construction. Estimated cost, $4,500.

Work has been started on the erection of a residence for J. A. Burns, 66 St Anne's Road. Architect, W. G. Burns, 74 Indian Grove. Approximate cost, $7,000.

Tomkins & Baskerville, 490 Oakwood Avenue, are receiving tenders on plastering, wiring, tinsmithing and installation of hot air furnace in connection with the residence which they are building on Kenwood Street.

J. Stone, 49 Coleman Avenue, is receiving tenders on plastering required in connection with the residences which he is building. Approximate cost, $5,000.

Sarnia Township, Ont.

Adam Storing, Concession 2, has let the general contract for the erection of a residence to John Ellnor, 128 Victoria

Street, Sarnia. Brick veneer construction. Estimated cost, $3,500.

Sault Ste. Marie, Ont.
The contract for plastering required in the erection of a residence for R. T. Lane, 10 Queen Street, has been awarded to W. Wray, 332 Albert Street, and painting to E. T. Grand, Queen Street.

Shawbridge, Que.
The general, masonry, and carpentry contracts for the erection of dormitory cottages for the Boys' Farm & Training School, 115 Mountain Street, Montreal, have been awarded to A. F. Byers & Company, 340 University Street, the terra cotta work to the National Fireproofing Company of Canada, Ltd., 78 Crescent Street, Montreal; steel work to Structural Steel Company, Ltd., 10 Cathcart Street, Monereal; mill work to Lafleur Industriel Incorporee, Ste. Agathe des Monts; heating and plumbing to P. J. Sullivan Company, Ltd., 326 Lagauchetiere Street W. Approximate cost, $25,000.

Smith's Falls, Ont.
The general contract for the erection of a residence for A. Leacock has been let to Fred Scott. Brick construction. Approximate cost, $3,000.

St. Catharines, Ont.
The contract for masonry required in the erection of a residence for A. Robinson, 6 College Street, has been let to Rymer Brothers, Nelson Street. Tapestry brick and stucco construction. Estimated cost, $8,000.

Toronto, Ont.
S. B. Green, 111 Evelyn Crescent, is about to build a residence for A. E. King, 35 Oakmount Road. Brick construction. Estimated cost, $4,200.

In connection with the residence in course of erection for R. D. Kilgour, 45 Willcocks Street, the masonry contract has been let to J. Aldridge, 128 Westmount Avenue. Carpentry by day labor.

Tomkins & Baskerville, 490 Ooakwood Avenue, have been awarded the general contract for the erection of a residence at 498 Rushton Road, and are now receiving tenders on plastering, wiring, tinsmithing, and hot air furnace. Estimated cost, $3,000.

The following contracts have been awarded for the erection of a residence on Warren Road for F. Cameron, c/o. F. S. Baker, Architect, Traders Bank Building: masonry, Gordon Brothers, 1 Delisle Avenue; carpentry, Walker & Robertson, 438 Delaware Avenue; plastering, Taylor & Nesbitt, 18 Havelock Street; roofing, G. Duthie & Sons, Ltd., 80 Widmer Street; painting, Cornelius & Company, 50 Walker Avenue; plumbing, heating, and wiring, Bennett & Wright, 78 Queen Street E.; steel work, McGregor & McIntyre, 1139 Shaw Street. Approximate cost, $15,000.

Westmount, Que.
In connection with the residence in course of erection for T. A. Hubley, 48 Windsor Avenue, the roofing has been let to Campbell, Gilday Company, Ltd., 793 St. Paul Street W., Montreal, and the electrical work to McDonald & Willson Company, Ltd., 99 Drummond Street, Montreal.

The roofing required in connection with the residences now being built for Harding & Heward, has been let to Campbell, Gilday Company, Ltd., 793 St. Paul Street W., Montreal, and the electrical work to McDonald & Willson Company, Ltd., 99 Drummond Street, Montreal.

In connection with the residences now being built by Charles Fyfe, 176 Mance Street, Montreal, the roofing has been awarded to J. Dunphy, 55 Barrie Street; plastering to F. A. Sims, 358 Madison Avenue; painting to H. W. Birtwhistle, 19 Clifton Street, and electrical work to J. B. Staton, 5410 Sherbrooke Street.

In connection with the residence now being built for the Roman Cathodic Commissioners of St. Leo, 360 Clark Avenue, the contract for steel work has been let to the Dominion Bridge Company, Ltd., Lachine; roofing to Duchamme Blais & Company, 1995 St. James Street; plastering to Z. Bouchard, 12 Bouget Street; painting to H. Gauthier, 396 Amherst Street, and electrical work to L. Ortiz, 376 Fabre Street.

Power Plants, Electricity and Telephones

London, Ont.
The Utilities Board will receive tenders until June 14th on the supply of three 200 k.v.a. hydro transformers. General Manager, E. V. Buchanan.

Sackatchewan Province.
The following Rural Telephone Companies have been empowered to borrow money for the construction of their proposed systems: Battlevale R. T. Company, $3,800. Secretary, J. A. Morrison, Waseca; Graham-Chatsworth R. T. Company, $2,500, Victor Rooke, Picnic; Longlaketon R. T. Company, $3,200, Herbert Fisher, Silton.

Warwick Township, Ont.
The Township Council propose to secure estimates on the installation of a hydro system. Clerk, Nathaniel Herbert, Watford, Ont.

Fires

Montreal, Que.
Factory of the St. Lawrence Wagon Company, Ltd., 34 King Street. Loss, $5,00. Repairs will be made.

Vancouver, B.C.
Fish plant and grain elevator owned by the New England Fish Company and Alberta Pacific Grain Company, Ltd. Loss, about $600,000.

York Mills, Ont.
Cottages, stables, garage and poultry buildings owned by F. B. Robins, 86 Glen Road, Toronto. Total loss, $30,000.

Miscellaneous

Toronto, Ont.
The Board of Control will receive tenders until June 20th for the supply of motor fire apparatus. Specifications at office of Fire Department, Adelaide Street W.

Late News Items

Esquimalt, B.C.
The Municipal Council have awarded a contract for construction of sewers to Warren & Stancombe. Estimated cost, exclusive of pipe, $8,000.

Halifax, N.S.
The School Board have let the general contract for the erection of a school on Young Street to Falconer & MacDonald, St. Paul Building, the painting to Walsh Brothers, Metropole Building, heating and plumbing to Farquhar Brothers, Barrington Street, and electrical work to J. Starr & Sons, Granville St. Approximate cost, $75,000.

Hamilton, Ont.
F. F. Dalley & Company, Hughson Street N., propose to build a factory on Burlington Street, at an approximate cost of $100,000, and work will start very shortly.

London, Ont.
William Jeffrey, 419 Simcoe Street, has been awarded the general contract for the erection of a residence for W. I. Spettigue, 261 Hill Street, and has started work. Estimated cost, $10,000.

Medicine Hat, Alta.
The sub-contract for the erection of a flour mill and elevators for the Lake of the Woods Milling Company has been let to the Fegle Engineering & Construction Company, 209 North Archibald Street, Fort William. Brick and concrete construction. Approximate cost, $200,000.

Quebec, Que.
E. A. Tremblay, 69 St. Nazaire St., has commenced the erection of a residence, estimated to cost $18,000. Brick and concrete construction.

Saguenay River, Que.
The report previously issued under this head with regard to the Dupont Powder Company is incorrect. The Company are not planning any construction work.

Sarnia, Ont.
The Board of Education have awarded the general contract for the erection of a school on Lochiel Street to Schultz Brothers & Company, Brantford. Smaller trades will be sub-let. Terra cotta, steel and stone construction. Approximate cost, $55,000.

Toronto, Ont.
W. S. Grimshaw, 462 Avenue Road, has commenced the erection of three duplex residences, estimated to cost $18,000. Smaller trades will be let. Architect, P. H. Finney, 79 Adelaide St. E.

Commissioner of Works R. C. Harris has recommended the construction of asphalt paving on eight streets, estimated to cost $59,300, and concrete sidewalks, estimated to cost $17,000.

William Cowlin & Son of Canada, Limited, Mail Building, who have the general contract for the proposed office building for the Trusts & Guarantee Company, desire to receive sub-tenders on all trades except plumbing, heating, ventilating and wiring.

Westmount, Que.
The general contract for the erection of a residence for J. F. Slessor, 4825 Western Avenue, has been let to Anglins Limited, 65 Victoria Street, Montreal. Terra cotta and brick construction. Approximate cost, $9,300.

Anglins Limited have also been awarded the general contract for the erection of three residences for Warden, Cook & Davidson. Brick and terra cotta construction. Approximate cost, $19,500.

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Principal Contents

Canadian Stone a Product of Quality Specially Suitable for Our Public Buildings

IT very often happens that the chief difference between two articles on the market, fulfilling similar purposes, and one of which meets the popular fancy while the other does not, lies in the relative amount of advertising these two articles have received. Indeed, it not infrequently happens that a product of decided superiority fails to catch the public fancy because it is exploited by a company whose reputation is not yet established, or who for some reason or other are not able to bring the necessary publicity to bear on the situation to arouse the public interest. In spite of our boasted individualities we are a good deal given to following our neighbor's lead and people, in general, buy what is being bought.

It is not entirely evident that some such reason as this is not responsible for the somewhat limited use of stone as a Canadian building material in the past and, as the business develops, for the increase in our import trade. It catches the popular fancy to go as far afield as possible for their requirements. Of course it cannot be claimed that there are not good arguments being advanced, and doubtless with reason, favoring the use of stone other than Canadian. What actually does seem to be a fact, though, is that Canadians have conceded these arguments without attempting to combat them with others favoring our home stone. We have lain down, in a sense.

* * *

Now, there are always at least two talking points for a salesman—price and quality. In the stone business, however, only the first appears to have been recognized. It seems to have been tacitly conceded that stone is stone and that ends it—that the quality of all stone is the same. Yet one has only to make a tour of the stone buildings in any locality to satisfy oneself that the lasting qualities of different varieties of stone are very different. Some crumble quickly, others discolor, and so on. On the basis of "quality" Canadian stone has never been assailed. It apparently maintains its appearance and its physical characteristics indefinitely.

This being the case the matter of cost ought surely to take second place, especially when this difference is, at best, only a matter of a few per cent. "Value for money received," then, would appear to be a much better talking point—and an entirely proper one—than "cost" alone.

* * *

Also there is another important feature in the use of foreign stone for Canadian buildings—the question of empire loyalty. It so happens that a very large percentage of our public buildings—schools, churches, municipal halls, etc.—are built of stone and, quite frequently, not Canadian stone. Could we not point to these permanent landmarks of our prosperity with greater pride if they were also illustrations of our own natural resources? Would not the use of purely Canadian building materials tend to engender in our youth a confidence in their home land and a more intense spirit of loyalty as a result of that confidence? What matters a few dollars in extra cost if the extra value, and much more, is there? We do not rake the foreign fields for teachers or municipal officers in the hope that we may get something cheaper. We do not bring children from foreign countries to fill the schools because our own children are not suitable. Why then should our public buildings, of all places, be robbed of the prestige of an individuality that would stamp them as "quality" and "Canadian"?

* * *

The present issue of The Contract Record is given over almost entirely to an illustrated description of Canadian quarries and quarry methods. We cannot claim to have covered the subject fully, for the field is as wide as the Dominion. It is confidently hoped, however, that the issue will serve the useful purpose of bringing this phase of our natural resources more insistently before the attention of Canadian engineers, architects, contractors and various municipal bodies. These men have it largely in their power to popularize our home quarries. On their attitude and their ideas of utilizing home resources will hinge in no small measure the immediate future of the Canadian quarry.

How Canadian Quarries Are Meeting Foreign Competition

HOW owners of Canadian quarries and cut stone firms have been able, by means of a duty, to meet the competition of Indiana limestone, is related in the following interview by a representative of The Contract Record and Engineering Review with Mr. John Quinlan, of John Quinlan & Co. and the Quinlan Cut Stone, Limited, Westmount, P.Q. Mr. Quinlan, who is president of the Montreal Builders' Exchange, also makes reference to the cut stone industry as it affects Montreal. He speaks with an intimate knowledge of the subject, having been in business for many years.

"Before the advent of United States stone and machinery," Mr. Quinlan stated, "we used the top portion of the quarry for rubble foundation work, the grey limestone, found at a depth of about 20 feet under the upper layers, being utilized for building purposes in Montreal. The Imperial Bank and the Windsor Hotel are examples of Montreal stone thus employed. The method of quarrying was largely by powder and hand drills. At the time that stone cutters did all the work by hand, powder answered the purpose fairly well, in view of the fact that very little value was placed on the material and workmen's wages were comparatively low. Of course, this method of quarrying would be useless in preparing stone to be cut by gang saws and planers.

"The most important change in the industry was caused partly by the use of concrete for foundations, which took the place of the rubble foundations, and therefore killed the market for the top portions of the quarries. The large advance in cutters' wages was also an important factor in the change. While it was possibly economical to blow out the stone and use the hammer to square up the smaller pieces of stone to hand to the stone cutters to finish the product ready for erection in the building, when wages were at the rate of 20c. to 30c. an hour, the situation was entirely altered when stone cutters were asking 50c. an hour. Besides these elements in the situation, there was the development of the soft stone quarries of the United States, where the monolithic quarries were worked with the channelling machine instead of by powder, the stone being also cut by gang and diamond saws and planers.

"At first the United States stone was imported in the rough, to be manufactured by a few Canadian firms who installed cut stone machinery in order to furnish the market with at least a home manufactured product. This meant, of course, that there was practically no demand for Canadian stone. At the same time our Canadian manufacturers believed that if our quarries were opened upon lines similar to those in the United States, that eventually it might be possible to produce good Canadian stone at a lesser price than it was being manufactured for at that time, but the market was already captured by the American article in so far as the raw material was concerned, and was being fast captured for the finished product. As a matter of fact, the majority of our large buildings erected during 1911-13 were built of American stone cut and finished in the United States.

"The Canadian Government—at our request—investigated the question and found there was absolutely no protection for our quarrymen and manufacturers, for the reason that the small duty levied was more than offset by the reduction in freight on the finished article. In order to encourage the manufacturer and the production of stone, the Government in 1914 imposed a duty on foreign stone, fully manufactured, coming into Canada sufficient to protect the home industry. Shortly after the duty came into force the war broke out, greatly reducing the amount of building here, but Canadian quarrymen and manufacturers, owing to the tariff, are able to supply, and are now manufacturing, all the cut stone that is being used in the Dominion. We are thus in a position to keep our plants going to a limited extent. We are also taking advantage of the dull times to develop our quarries and to install the newest machinery.

"Personally, I hope before the war is over to market Canadian limestone in every way equal to any that has been imported, and at such prices that it will be advantageous to the Canadian consumer to use it. The old buildings in Montreal are examples of our local limestone. It has, for many purposes, excellent qualities, and I hope that its use will be more frequently specified by our architects."

Steel of Special Quality Required for Rock Drills—Subject to Unusual Strains

ROCK drilling in quarries is now prosecuted almost entirely by machine drills. They have a great advantage over the human power plant, because the lost motions and wasted energy in the latter are not only fatiguing, but discouraging. It is the question of results which makes the average laborer's work efficient or inefficient.

The development of hammer-drill machines during the past decade has brought with it high requirements for the drill steel. The steel generally used for rock drilling is a carbon steel and its hardness is dependent upon the percentage of carbon contained. Experience has proven that the proper percentage of carbon is governed chiefly by the hardness of the rock to be drilled and the power of the machine. A bit will not stand the impact if too hard a steel is used on hard ground.

In some drilling practice, as for instance, when hand-feed drills are used, bending stresses are likely to be put on the steel. Additional tensile and compressive stresses are thus induced during the period of the blow, producing an excessive strain in the steel. In such practice a heavy size of steel is to be recommended. Abrupt changes in section and sharp corners should be avoided in drills.

To obtain the finest grain, bits should be forged continuously from the highest temperature employed down to the finishing temperature, which probably is slightly above the point of recalescence. It is advantageous in hardening not to treat it to any higher temperature than necessary. The steel is liable, if heated too highly, to change into a coarse crystallization and develop hardening cracks that may cause ruptures. The shank should also be properly tempered after being hardened.

Shanks often rupture longitudinally, due to careless straightening after the steel has been upset, blemishes in the steel, and groove marks where numerals or other marks have been stamped. The structure of steel used in bits subject to vibrations is of the greatest importance. The car bit structure has been found to stand up best. It is obtained either by cooling the steel quickly through the so-called critical range, without actual quenching, or by rapid cooling and then reheating to about 600 degs. C.

The Merits of Canadian Stone—A Candid Opinion Covering the Fact Fairly

THE Superintendent of Buildings of the Board of Education of one of our largest Canadian cities, who was recently in search of information regarding the merits of Canadian stone, wrote to the management of one of our largest quarries for a candid opinion on the relative characteristics of the various stones that from time to time had come into competition for the school buildings in that city. The following reply was received from the president of the company, and appears to us to state the case for Canadian stone very clearly and fairly:

The following stones are, you are no doubt aware, some of the finest and most durable that can be found anywhere, and, although in some cases there has been a difficulty in obtaining a large shipment, still, that could be remedied if the quarrymen had encouragement given them by the public bodies specifying their use.

Credit Valley

This is a sandstone of uniform color, mostly gray, fairly soft when quarried, hardening with age. Can be cut at reasonable cost on plain work, but, on account of its hardening quality, is slightly higher in price on any ornamental or highly detailed work. The cost of this stone, f.o.b. cars your city, is 55 cents per cubic foot, in rough quarry blocks.

Wallace Sandstone

This is of the same texture as the above, of an olive color, and the cost is seventy cents per cubic foot in rough quarry blocks.

Miramichi

A sandstone of olive color, somewhat softer than either of the above to work and the cost is seventy cents per cubic foot in rough quarry blocks.

Sackville Freestone

A rich brown in color; soft in texture, and therefore easily worked for little, if any, more than the Indiana, U.S.A., stone. The cost is eighty cents per cubic foot f.o.b. your city, in rough quarry blocks.

Queenston Limestone

Blue-gray in color, with a small percentage of buff. Is not unlike Bedford Indiana in appearance, but is unlike that stone in that it is not porous and therefore will not discolor or stain. Is harder and therefore a little more costly to work in ornamental or fine detail work, but, in plain work, can be worked as freely as Indiana. The cost is fifty cents per cubic foot f.o.b. your city, in rough quarry blocks.

Tyndall Limestone

Comes from Manitoba, and on account of the excessive freight, has, so far, not been used very much in the East. I understand, however, that the railways are considering a lower freight rate, which will make it more reasonable. It is similar to Indiana in texture but has a mottled effect in blue and buff colors. A good sample of this stone can be seen in the new C. P. R. station at North Toronto, now nearing completion.

These stones are all of Canadian production, and when you compare the prices with the Bedford Indiana at sixty-four cents per cubic foot, and the Cleveland Sandstone, Gray Canyon, at sixty-five cents per cubic foot, and Buff, at one dollar and ten cents per cubic foot, all f.o.b. your city, the differences are so very small that, obviously, the extra cost of using Canadian stone is in the cutting, and that is of necessity by the wording of your specification, "to be done in the city." Therefore, by using Canadian stone, you not only encourage Canadian industries, but you provide more work for the citizens of your city (who are the ratepayers who provide the money for these works) at, I venture to say, very small extra cost. If your department would specify more Canadian stone, I am sure there is plenty of capital ready to be put into developing this industry, thus assuring an adequate supply.

For your further information I would say that the duty on rough blocks entering this country is about seven cents per cubic foot, and on stone planed, turned and sawn four sides, that is, practically cut ready to set, the duty was formerly forty-five cents per cwt. This is equivalent to about sixty-five cents per cubic foot, to which must now be added 7½ per cent. clear face.

These facts, I think, are sufficient to show you that, at a not too large extra cost, Canadian stone could be used for all purposes in your school buildings, and in the case of plain work, such as bases, etc., they could be used at the same cost, and give work not only to local workmen, but, in its entirety, to Canadian workmen.

The Canadian Stone Business

By C. Cecil Howlett*

THE question, What is the matter with the Stone Business? is one that must present itself with unmistakable emphasis to the owners and operators of quarries at this time. The answer, in the opinion of the writer, is lack of concerted effort on the part of those interested in the industry to check or correct abuses as they occur. At a time when the country is just emerging from a long period of depression, the stone business has not yet felt the livening influence. This dullness, however, seems to affect only our native stone. Foreign stone apparently finds a ready market in our cities.

The following appear to be the principal causes productive of this state of affairs, all of which are capable of being materially reduced in their effect, or entirely removed, by organized effort on the part of the various stone producing interests in the country:—

The lukewarmness of our architects generally, who seem to have drifted into the habit of overlooking our native building stones, but are thoroughly familiar with the merits of the various foreign products which are cutting so seriously into the market. The remedy for this would appear to be a general advertising plan, showing forth the particular merits of the various building stones of this country and directed chiefly to the attention of the architectural profession. It cannot be believed but that if this profession understood the injury being done to a great Canadian industry they would do all in their power to remedy the matter. If, in specifications, the name of the foreign country from which the building material is to be obtained, were given, instead of the particular name of the material, or if the name of the country were named in connection with the name of the material,

* Manager Longford Quarry Co., Longford Mills, Ont.

it would be quickly brought to the attention of the deciding parties that they were, probably inadvertently, discriminating against a Canadian product.

Then there is the freight question and the car supply. These are matters in which the various quarry companies are absolutely at the mercy of the transportation companies. The freight cost of a car of stone in almost all cases, is greater than the value of the material. The idea on the part of the carrying companies seems to be to take toll of all the traffic will stand. The matter of securing cars for shipments is also a very serious one and has a tendency to influence contractors to buy building material of foreign origin, stocks of which are ready to hand in most centres, or use concrete.

Organization of the various concerns interested in the stone business would certainly go a long way towards keeping the merits of stone as a building material of the first class before the constructing community. This latter is badly needed. An intelligent educational campaign keeping the proper place of the various building materials well before those interested would be a great benefit to the general community as well as to the interests involved. The harm where a mistake is made in the choice of a material reacts to the disadvantage of the material employed.

There is a great future before all those industries dealing with construction in this country. As the population increases and our natural resources are further developed there will be an ever greater need for housing our people and products, and with the natural increase in wealth our buildings will become more and more an index of the general prosperity.

Developments in the Quarrying Business

War conditions and the high prices paid for unskilled labor in munition factories, have put most of the quarries in a bad way for labor. The subject of new and improved equipment is being given the fullest consideration by quarrymen who recognize that the shortage of quarry labor is a condition that can be met in no other way. Mechanisms are being produced that are enormously economizing the production of building and crushed stone.

Auto Trucks—Road material, always the heaviest portion of the tonnage going out from the crusher, is in big demand at the present season. The transportation proposition is ever present, and just now, with the shortage of labor and the acute pressure of railroad cars, the auto-truck with trailers added seems to be the only economical solution. As a result, autotrucks have become practically an indispensable part of the road contractors' equipment. The transportation end of road making is always the most important, because it has all to do with the profit that is made by the road contractor.

Fluxing Stone—With steel mills of every class running at full capacity to meet the unprecedented demand for steel and iron, a maximum volume of fluxing stone for furnace operations is required. Quarries producing fluxing stone are likely to have, during 1916, the greatest demand ever known for this particular type of product.

Requisite Features of Stones

Structural stone is employed for so many diverse purposes that the characteristics which make a stone desirable necessarily vary with the nature of the structure to be erected. For building piers for railway bridges, strength and durability are far more important requisites than uniformity of color. While for interior decoration, less durability is necessary, although such stone is expected to exhibit greater beauty and a superior durability to fine chiselling.

The main requisites for a stone are: (1) strength —crushing strength, transverse strength, and elasticity; (2) color; (3) durability; (4) low cost of cutting.

The ordinary physical tests which are commonly applied to building stones to determine its adaptability are: specific gravity, weight per cu. ft.; per cent. of pore space; ratio of absorption; coefficient of saturation; crushing strength; transverse strength; shearing strength; corrosion loss; drilling factor; chiselling factor.

Market Conditions in Hydrated Lime

There are three plants in Ontario manufacturing hydrated lime, located at Guelph, Elora, and Orangeville, respectively. Other producers in Canada are located at Joliette and Hull, Que., and Winnipeg, Man. There has been in the past a large amount of hydrated lime imported into Canada annually from the United States for use as finishing plaster. Canadian plants are able to produce a considerable tonnage, but have not been prepared to take care of the unexpected increase in demand this spring, resulting from the increase in price of the United States products and the increase in duty caused by the recent action of the Canadian Customs in placing hydrated lime in the same class as wall plaster and Portland cement. Canadian firms expect, however, to be in a position shortly to take care of all the business offering, but are handicapped just at present by the high prices and scarcity of labor and slow delivery on orders for machinery and supplies, which are the same difficulties that obtain in all other classes of manufacturing in Canada to-day.

Right Time to Quarry

The best time for quarrying is during the summer, but freshly quarried material should not be allowed to lie in the sun and dry too quickly, as it is liable to become shaky. Stone quarried during the winter, or during very wet seasons, is liable, according to some authorities, to have much lower tenacity when dried, and to remain particularly susceptible to the effects of moisture. A stone is also liable to disintegration if built immediately into a wall without seasoning. Stones for carved work should be worked up as soon as they are quarried and while in the green state, as, when the water is once lost, no amount of wetting will restore them to the original workable condition.

Quarry Drainage

The question of drainage is extremely important in locating a quarry; given the same market, it is impossible for a wet quarry to compete with a dry one, as the additional expense of keeping the excavation free of water may compel the cessation of operations. Where possible, therefore, a quarry should be located where natural drainage is presented. If such a place cannot be found on the property, the operator must reckon with the cost of pumping, and he should assure himself that his competitors are not more favorably situated in this respect.

Geological Features of Canadian Rocks

A Brief Account of the Historical Formations Which Form the Basis of Our Splendid and Varied Quarries.

THE following brief account of the geology of the rocks of Canada, so far as known, is given with the object of indicating the extent and manner of formation of the rocks which are employed as building stone. The most ancient rocks that compose the crust of the earth consist of a series of gneisses, granites, and other crystalline rocks, intermingled with sedimentary materials which have likewise become crystalline through metamorphic agencies.

Pre-Cambrian

This crystalline complex forms the axis or backbone of all the continents, and on its flanks have been deposited the sedimentary rocks which have greatly increased the original extent of the continents. This ancient series is usually referred to as the "Pre-Cambrian." It is also known as the "Azoic," in reference to the fact that no life is known to have existed on the globe during the vast period of time during which these rocks were formed.

Palaeozoic Period

Following the Pre-Cambrian came a long period of many millions of years during which the oceanic waters successively invaded and retreated over certain areas. During this age, which is known as the "Palaeozoic" on account of the fact that a very ancient and extinct type of life existed, the flanks of the old Pre-Cambrian axis were gradually covered with a series of sedimentary rocks. It is apparent that many changes must have occurred during the Palaeozoic era, and that these changes have left evidence whereby the rocks may be divided into systems, and these systems further subdivided into formations. From the oldest to the youngest, the systems of the Palaeozoic are as follows: Cambrian, Ordovician, Silurian, Devonian, and Carboniferous.

During "Cambrian" time the ancient ocean advanced on the Pre-Cambrian axis and its waves beat into sand the fragments of the old rocks which they encountered. In consequence, a fringe of sandstone marked the strand line of the advancing sea, while in the deeper water was deposited the finer material, which consisted chiefly of suspended particles of clay. Cambrian rocks are marked off from the earlier series by the presence of fossils. In some cases numerous fossils are found, indicating beyond doubt the age of sediments; in most cases, however, the intense metamorphism has destroyed the remains of any organism that may have existed. In consequence of these changes, much doubt exists as to the proper age of the rocks of many large areas.

Sackville Sandstone Quarry, Sackville, N.S.

The series of deposits following the Cambrian are classed under the term, "Cambro-Silurian." The rocks of this age are chiefly sandstones, limestones, and shales, usually showing strong metamorphism with the conversion of the sandstones into quartzite, the shales into slate, and the limestone into crystalline limestone. The formation has been invaded by great masses of granite and other eruptives whereby its extent is materially reduced. A period of extensive land elevation and deformation, accompanied by the extrusion of great masses of igneous rocks, marked the close of the "Cambro-Silurian" time.

Following the Cambro-Silurian are the deposits of "Silurian" time, which show less extensive metamorphism although they are invaded by eruptives of a still later age. The rocks consist chiefly of calcareous shales and limestones.

Devonian rocks follow the Silurian; they consist chiefly of shales and limestones with sandstones and conglomerates. Towards the close of the Devonian, extensive earth movements again affected the region. The rocks show evidence of uplifting, with much folding and faulting, accompanied by the injection of enormous masses of granite and other igneous rocks.

Following the "Devonian" came the "Carboniferous" age, which represents a great series of sediments deposited in a sea that gradually encroached on a lowering land surface. The rocks of the Carboniferous proper are divided into three series—lower Carboniferous, middle Carboniferous, and upper or Permo Carboniferous. During the "Carboniferous" time, tilting and disturbance of the strata occurred, so that in some places the different members of the series are already marked off from one another by strong unconformities. The close of the "Carboniferous" age was marked by a wide-spread elevation of the land, which in some places has not been followed by depression.

Mesozoic Period

The only rocks of later date than the Permian belong to the lowest division of the "Mesozoic" age, and are thought to represent estuarine deposits. They consist of red sandstone and shales, which are overlaid by heavy masses of trap.

Ice Age

At a comparatively recent date in geological history occurred the remarkable event known as the "Ice Age," during which the whole of Canada was swept by enormous glaciers, which did much to modify the topography of the country. In their resistless march from the north these glaciers bore immense quantities of boulders of the crystalline, Pre-Cambrian rocks far southward. With the coming of warmer climate and the consequent retreat of the ice, these boulders were left in great numbers over the face of the country.

Dimension Quarrying by the Ancients

Incredible Accomplishments that Stagger the Minds of Modern Builders—Methods of Operation Almost Complete Mystery—A Few Interesting Figures

MERE magnitude alone makes appeal to mankind. Almost every one is interested in the great things of their kind, no matter what they may be. In every age there has been the effort to surpass previous achievements. The Egyptians as a nation are chiefly notable for their grandiose work, and the result is that the pyramids, the Sphinx, and various giant obelisks and monster temples stand as their principal monuments. The Egyptians worked in stone, as does every nation that wishes to leave imperishable records of their civilization. The natural tendency of this people was helped by the fact that close at hand were inexhaustible deposits of high-grade stones, limestones, sandstones, quartzites, granites, syenites, basalts, and porphyries. The manner in which the Egyptians quarried these stones in huge monolithic masses, transported them for immense distances, and erected them into stately piles of masonry, is one of the marvels of history. Some of their work was of almost inconceivable magnitude. The two Colossi of Memnon at Thebes, are carved of a pebbly and quartzoze sandstone conglomerate of a yellowish brown color and very difficult to work. The height of the statues alone is 52 ft., and of the pedestals 13 ft. They represent Amenophis III., who erected them in 1427-1392 B.C. The northern one was the famous vocal statue of Memnon, which was reputed to give out a song as the rays of the morning sun smote it.

One striking manner in which Egyptian art manifested itself was in the erection of obelisks, or carved monolithic shafts of stone. One of these is the famous Cleopatra's Needle in Central Park, New York. This is of granite, 57 ft. in height, and its transportation from Egypt and erection in New York were considered quite a triumph of modern engineering. And yet this is but a moderate example of this style of work. In front of the Lateran Palace, in Rome, there is a monster shaft of red granite, 105 ft. high and weighing 430 tons. This was originally erected by King Tutnes III. (B.C. 1597-60), at Thebes, and was removed to Rome by Constantius, 357 A.D. It was overthrown and broken into three pieces before it was erected on its present site by Sixtus V., in 1587. The next largest obelisk is at the ancient Heliopolis, near Cairo, which measures 97½ ft. in height and 8½ ft. square at the base. This is of rose granite from Assuan, and was erected by Queen Makere about 1500 B.C. An inscription records that it was made in seven months, surely a remarkably short time for so great an achievement in quarrying, stone-cutting, and engineering.

If linear dimensions alone are taken into account, the Lateran obelisk undoubtedly holds the record, but as to mass and general magnitude, nothing in the way of quarried stones will compare with those that were used in the temple of the sun at Baalbec, in Syria. The remains of this wonderful structure still stand in a fair state of preservation. It is made up entirely of enormous blocks of stone laid up in dry masonry with close-fitting joints. The base courses of this temple are of blocks ranging from 20 ft. to more than 60 ft. in length. They are all surpassed, however, by a block which was cut from the ledge, squared up and partly removed from the quarry about half a mile from the temple itself, but left there when the work was finally suspended. An idea of its size can be gained from the accompanying data, but the exact statistics make the work of the ancient artisans even more remarkable. This Block has the almost incredible dimensions of 75 ft. by 18 ft. by 15 ft., and weighs fully 1,500 tons.

In recording the largest blocks quarried, the reference is, of course, to those that have been not alone broken off from their beds, but have also been removed from the pit, dressed, and erected. With modern explosives, drills, and quarrying apparatus, it is no unusual thing for a mass of rock weighing many thousands of tons to be broken loose and overthrown, but these great blocks are cut into smaller pieces before being removed and worked. About the year 1875, the proprietor of the Prentice brownstone quarries, in Michigan, quarried a single shaft of stone slightly over 100 ft. in length. It was intended to use this as a display at the Centennial Exposition in Philadelphia. It was found, however, that it would be impossible not only to remove this from the pit, but also to transport it to Philadelphia. It was, therefore, broken up into smaller sizes for commercial use. No one would be bold enough to declare that modern ingenuity would find it impossible to equal the gigantic blocks that find a place in the Temple at Baalbec, but they are likely to stand for all time as the record in stone quarrying.

A Canadian Quarry for Every Purpose

The Origin and Mineral Composition of the Chief Canadian Building Stones, Manner of Occurrence, Variations and Classifications

THERE is scarcely any variety of stone which may not be used for building purposes. Cheapness and accessibility often outweigh all other considerations and, where time is limited, are the chief and controlling factors. In a restricted sense, building stones fall into four groups designated as follows: (1) Granite and its allies, the igneous rocks; (2) Sandstones and related rocks; (3) Limestones and related rocks; (4) Slates.

By exceptional beauty, rarity and adaptability, many members of the above groups may pass over the indistinct line which divides building from ornamental stone. On the other hand, the so-called ornamental stones pass by a similar insensible gradation into gem stones. Ornamental stones, therefore, constitute a group, which is not clearly defined either scientifically or economically.

Some of the more important essential minerals of igneous rocks are briefly described below.

Quartz

Quartz is a crystallized form of dioxide of silicon, and is one of the commonest substances known. Besides being a constituent of many igneous rocks, it forms the bulk of common beach sand, as well as the solid sandstone rock. It is the hardest of the common minerals and will cut all those referred to below. It is normally colorless, like clear glass, but may be milky white or tinged with various colors, as pink, grey, and blue. The superior hardness of quartz, as well as its resistance to decay, renders it a very permanent substance, and it persists in almost unaltered form after the other minerals have disintegrated. Quartz is an essential constituent of many igneous rocks, particularly of granite and prophyry. Its presence in proper amount renders such a stone hard and permanent, but an excess causes difficulty in chiselling and consequently an increase in the cost of working.

Morrison Quarry Company's Masson Quarry, near Montreal.

Feldspar

The feldspars are complicated compounds of silicic acid with lime, soda and potash, and may be grouped in two divisions based on the substance combined with the silicic acid. In one case this substance is potash and in the other soda or lime, or both soda and lime. Owing to the ease with which feldspar cleaves, it is often filled with incipient cracks which allow the penetration of water, whereby decomposition is more readily effected. It sometimes happens that the feldspar crystals of a rock are so large or constitute so great a portion of the whole mass, that the quarrying of the rock becomes an economic possibility purely on account of the feldspar it contains.

Mica

Chemically, mica is a complicated compound of silicic acid with several other substances, particularly potash, magnesia, and iron. Mica is a common constituent of rocks, particularly of granite, the color of which is more or less controlled by the amount and color of the mica present.

Pyrite

Pyrite or iron pyrites is a compound of iron and sulphur, which usually crystallizes in cubes of bright, yellow, metallic color; its popular name is "Fool's gold." Pyrite in exterior building stone decomposes easily, resulting in unsightly stains. Its presence in small quantity is not prohibitive for inside construction, but for exteriors any appreciable amount is to be regarded with the gravest distrust. It is a fairly common accessory constituent of rocks, not only of the igneous types, but of other kinds as well.

Igneous Rock

Igneous rock is formed from molten matter which has consolidated either into minerals or glass, or both. Many classifications of a more or less satisfactory nature have been devised; but as yet all sorts of gradations are known to exist between the various types. Some of the more common varieties employed as building stone are classified below:—

Granite—The term, "granite," has been used in various senses and has been made to include many different stones; it has even been considered synonymous with "igneous rock." The physical character of a rock depends on two things—its mineral constituents and its structure. In a typical granite the constituent minerals are quartz, orthoclase and mica; the first two are always present, while the mica is frequently replaced by augite or hornblende. In its structure, granite is composed entirely of minerals; there is no glass or uncrystallized material between the constituent grains. Further, the various minerals are of approximately the same size. Variations in the size of the grains produce granites varying from extremely coarse examples with crystals of an inch or more in length down to those in which the grains are of microscopic size.

As the different minerals possess different colors, it is apparent that the relative amounts of these minerals is an important factor in determining the color of the rock as a whole. Granites are usually classified as grey or red, but a whole series may be selected ranging from almost white to a deep, bright red. In addition to the essential minerals, granites are prone to contain accessory constituents, such as garnet, pyrite, magnetite, hematite, and many others.

Prophyries—The term "prophyry" was at first employed to designate all those igneous rocks in which certain of the crystals are conspicuously larger than the rest. Modern usage, however, has somewhat restricted the use of the term, but the adjective, "prophyritic," is still applied to all rocks in which some of the minerals are conspicuously larger than the rest. Many of the prophyries, particularly those with large, bright-colored prophyritic individuals embedded in a darker ground mass, are of unusual beauty when polished, and are much in demand for decorative purposes.

Greenstone—"Greenstone" has been applied to rocks of very different composition and structure and has no real significance. It will be continued to be used, however, because it aptly describes a series of rocks presenting a dark green or black color, the differentiation of which is often attended with considerable difficulty. In composition they are all characterized by the practical absence of both quartz and orthoclase. The minerals which compose the greenstones are more prone to decay than those of the granites. They do not generally appeal to architects for building.

Sedimentary Series

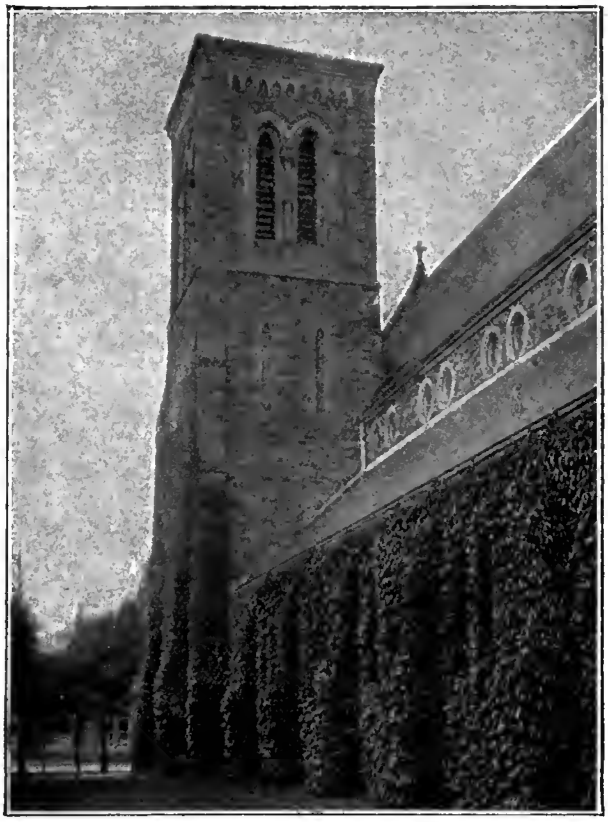
To the sedimentary series are ascribed all those deposits which have accumulated at the bottom of bodies of water. It is obvious that these materials must have been derived from the land surface and transported into the sea or lakes, either by solution in the water or by mechanical carriage in the rivers or streams. It is further obvious that any of these materials which make up the igneous rocks may be removed on the decay of those rocks and thus go to make up the sedimentary series. The more or less complete decomposition of the original minerals of the igneous rocks results, however, in the formation of new minerals which go to make up the sedimentary series. Further, after the sedimentary rock is formed, other new minerals may originate by chemical changes within the rock. Of the sedimentary or stratified rocks formed from the solidification of the masses of material borne into the sea the more important are described below:—

Sandstone—The comminuted mineral particles, derived from the original igneous rocks, and washed down by streams into the ocean, build up layers of material which eventually become rock. In distributing these particles, the well-known sorting power of water comes into play, whereby the sand-like grains are separated, on the one hand, from the coarser fragments, and on the other, from the finer particles of kaolin. The sandy portion consolidation becomes sandstone. The character of sandstone depends on the mineral character of the component grains, the size and shape of the grains, their arrangement within the rock, and the nature of the cementing material binding them together.

Particles of quartz form by far the most desirable constituents of sandstone; feldspar is also frequently present. Among the less frequent mineral grains found in sandstones may be mentioned, hornblende, chlorite, garnet, magnetite, and calcite. In the best sandstones the grains are arranged uniformly throughout the mass. Frequently, however, the coarser and finer particles are arranged in layers, thus giving a striped appearance to the stone, together with a pronounced tendency to break parallel to the various sheets. Of equal, if not greater, importance than the constituent grains themselves, is the nature of the cementing material by which the grains are bound together. This cementing material may be silica, carbonate of lime, oxide of iron, or clay. Sandstones are usually spoken of as siliceous, calcerous, ferruginous, or argillaceous, according to the nature of the cementing material. Siliceous sandstones have the greatest strength, but they are frequently so hard that they cannot be chiselled, except at prohibitive cost. Calcareous are soft and may be worked with comparative ease; but succumb readily to the action of weather. Argillaceous sandstones are usually dull and unattractive, and are liable to absorb water and disintegrate under the action of frost. In color, sandstones are extremely variable, ranging from almost white to dark brown; grey, buff, drab, bluish, and greenish types are common.

Limestone

Limestone is composed essentially of carbonate of lime which has been deposited on the floor of bodies of water and has subsequently hardened into rock.



Niagara Limestone, St. Patrick's Church, Hamilton, Ont.

The precipitation of the lime may have been effected directly from the water or by the agency of animal or vegetable life, that is, the limestone is a chemical precipitate, or it is composed of the shells and other hard parts of animals, as well as the hardened tissue of certain plants.

Compact limestone is only occasionally pure carbonate of lime, in which case it has a high value for the manufacture of chemical products. Any considerable amount of clay is not desirable in a limestone as it softens the rock and renders it more liable to disintegration. A very fine grained, uniform, magnesian limestone, with a small amount of clay, is known as lithographic limestone. Hydraulic limestone contains a considerable amount of clay and, when burnt, yields a cement capable of setting under water. A rock so diversified as limestone must necessarily present many different colors. White, grey and drab are the prevailing tints, yellow, blue, and green are of frequent occurrence.

Metamorphic Rocks—Rocks of either igneous or sedimentary origin are often subjected to such severe treatment in the long course of their geological history, that the original character is much altered. The folding and crushing of the earth's crust, the immense weight of overlying material, and the contact with hot molten rock from the interior may be mentioned among the numerous causes contributing to the change. Such altered rocks are referred to as "Metamorphic."

Marble—Although the term "marble" is frequently applied to handsome varieties of sedimentary limestone, particularly the fossiliferous examples, it seems advisable to restrict the name to the metamorphosed limestones—to those in which the crystalline structure has been induced by metamorphism. The term has been used in a general sense as any kind of limestone capable of receiving a polish. Marble, in the narrower sense, is a fine, even aggregate of calcite crystals which has been produced from ordinary limestone by the action of heat and pressure. When pure it is snow white and is known as statuary marble. The different colored marbles sometimes present the different hues, pink, red, grey, blue, etc., throughout the mass. The arrangement of the coloring matter is due to the aggregation of the impurities originally present in the limestone and their conversion into new minerals by the process of metamorphism. Marble is found only in regions which have been subjected to severe strain, in consequence of which the originally level beds of limestone have been bent and folded to such an extent that they are sometimes vertical instead of horizontal in position.

Slate

Highly metamorphosed beds of shale which have been subjected to a strong lateral pressure become much hardened and at the same time acquire a tendency to cleave in a direction at right angles to the line of pressure. It should be clearly understood that the familiar sheets of slate are not the result of bedding planes, but are consequent upon the development of "slaty cleavage," which takes place in a direction in no way related to the planes of stratification. Slate deposits are, therefore, always found "standing on edge." They are usually of limited width, but may extend for miles along the direction of cleavage. Green to grey varieties are by far the more common, but purple, red and mottled slates are quarried to a considerable amount.

Field Stones

The loose stones so generously scattered over a large part of Canada and so universally used in the construction of foundations, and even dwelling houses and churches in rural districts, cannot be ascribed to any particular type. A great many different kinds of stone may be obtained from among these loose pieces within a very limited district. All these materials have been derived from the northward of the localities in which they are now found and have been borne to their present position by the action of ice during the comparatively recent "Ice age" or "Glacial period."

Occurrence of Various Building Stones

Present Knowledge More Complete with Respect to Eastern Canada—Large Deposits Widely Distributed

THE ensuing description will deal with the occurrence of the more important building stones, according to their geological formation, in Ontario, Quebec, and the Maritime Provinces. The description will include a brief summary of different areas that have been actually exploited for the production of building stone.

ONTARIO

Sandstone

The sandstones quarried in Ontario are obtained principally from three formations—Potsdam-Beekmantown, the Medina, and the Oriskany. Small quantities have also been obtained from the Chazy, and they are likewise known to occur in the Trenton.

Potsdam-Beekmantown—The advancing ocean, which encroached on the old Archaean continent in early geological time, caused a shore line deposit of sandstone to be formed. As this oceanic advance continued through both "Potsdam" (Upper Cambrian), and "Beekmantown" time, and as the sandstone rarely carried any distinctive fossils whereby its age may be determined, it is usual to designate the stone by the term, "Potsdam-Beekmantown" sandstone. The actual outcrops of the rock are always found adjoining the Archaean. To the westward the fringe of sandstone has been largely covered by later deposits, and, to the eastward, its outcrop is very irregular. The following geographical areas of Potsdam-Beekmantown sandstone are well known: South Frontenac, Brockville, Rideau, Smith's Falls, Perth, Mississippi, Nepean, and Prescott.

The stone of the Potsdam-Beekmantown is mostly hard, white, and flinty, with brown spots and checks; the workable varieties are the exception to the above rule. On the whole, they are hard and not adaptable to fine work. Much of the stone makes excellent rubble and random coursing and for rock-face work it is very desirable.

Medina—The sandstone band of the Medina formation has an average thickness of 12 feet; it represents a shore deposit at the opening of "Silurian" time. The quarries exhibit irregular bedding which has proved a great hindrance to the profitable extraction of the stone. Most of the beds are fine grained and present, roughly, three types, brown, white or grey, and mottled. This stone is found chiefly in the Niagara, Milton, Credit Valley, and Orangeville areas.

Oriskany—After the deposition of the Salina beds there was a considerable period of erosion during which masses of sand were distributed by the wind over the low denuded country. The advancing sea rearranged these accumulations of sand to a greater or less extent, and produced a series of beds known as the "Oriskany" formation. This series is seen near Waterloo, on the Niagara River, but the only area of any importance occurs in the townships of Oneida, North Cayuga, Walpole, and Townsend, in Haldimand and Norfolk Counties.

Limestones

The Province of Ontario is rich in limestones of various kinds, some of them well adapted to building purposes, others more particularly to heavy construction. East of the Archaean axis, building stone is obtained from the Beekmantown, the Chazy, the Black River, and the Trenton formations. West of the axis the chief formations yielding good stone are the Black River, the Trenton, the Niagara, the Guelph, the Onondaga, and the Hamilton.

Beekmantown—This formation consists chiefly of different types of dolomitic and sandy limestones and is found in the following areas: the St. Lawrence area, around Brockville and Prescott; the Mountain area, around east Dundas; the Lanark area, around Smith's Falls, Carleton Place, and Almonte. This formation produces a heavy, dark colored limestone suitable only for heavy construction, a crystalline limestone with varying amounts of sand, extremely hard but durable, and a granular crystalline dolomite of brownish color, softer and more desirable as a building stone.

Chazy—After the "Beekmantown" era, another great advance of the sea marked the "Chazyan" time. The upper beds of this formation, the limestone portion, contains some fine stone adapted both to heavy construction and to architectural purposes. The distribution of quarries of this formation is indicated in the following division of areas: the Central Dundas, the Sheek Island, the Prescott, the Ottawa, the Lanark, the Eganville, and the Pembroke.

Four rather distinct types are produced from this formation: (1) a hard, heavy, dark-colored stone, hard to chisel, adapted to rock-face work and heavy construction; (2) a lighter colored grey stone; (3) a fine encrinal limestone of light blue-grey color—this is a high grade stone, easy to chisel, of excellent appearance, and suitable to either heavy construction or architectural work; (4) a fine grained, dark-colored, soft stone, with a muddy aspect on weathering, used for bridge work.

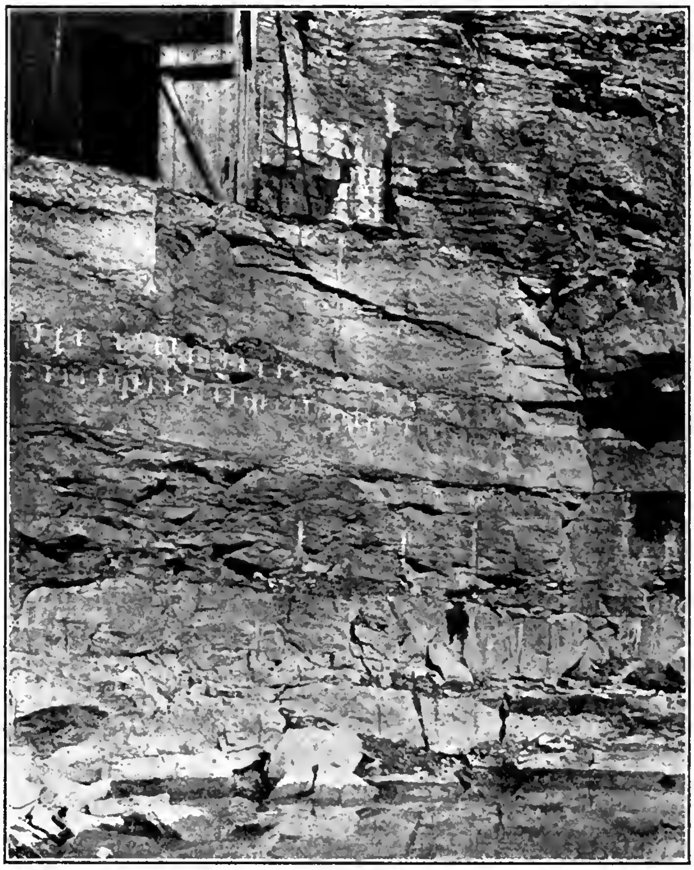
Black River—Overlying the Chazy limestones and shales are a series of beds which represent later stages in depositions of the same marine invasion. The Black River formation consists of dark and heavily bedded limestones, usually of quite limited thickness and geographical extent, and of lighter colored, compact stones of lithographic character. The quarries of this formation may be conveniently grouped under the following geographical areas: Stormont, Glengarry, Ottawa River, Carleton, Dirleton, McNab, Renfrew, and Western. This latter area constitutes a narrow band extending along the western flank of Archaean rocks from Kingston to Georgian Bay, comprising the following districts: Kingston, Napanee, Belleville, Crookston, Madoc, Marmora, Burnt River, Longford, and Georgian Bay. The stone is mostly a fine grained, compact variety, approaching the lithographic in character.

Trenton—Although the rocks of this formation are wide spread, there are not many quarries throughout its whole extent. The only important quarries now in operation are those near Ottawa. The following areas of Trenton rock may be recognized: the Ottawa River, Stormont, Glengarry, Carleton, Renfrew, and the Western, which consists of the following districts: Belleville, Prince Edward County, and Peterborough.

Niagara—The limestones of this formation constitute the upper part of the escarpment reaching from Queenston Heights to the Bruce peninsula. Along this line numerous quarries have been operated from which excellent stone for both heavy construction and for architectural purposes, have been obtained. The Niagara stone is generally of a dolomitic character, usually of a light color with a yellowish cast, and is more porous than the stone from the older formations. The quarrying industry is centred around the following points: Queenston, Thorold, Beamsville, Hamilton, a central area, and Owen Sound and Wiarton.

Guelph—Owing to the heavy covering of soil, the exact boundaries of the Guelph formation are difficult to determine. The formation consists of magnesian limestones which may be recognized by their light yellowish color and porous character. The following areas may be recognized: Galt—Guelph, Fergus—Elora, and Glenely. This stone is quarried with facility, but the beds are irregular, requiring considerable work to make the stone suitable for coursing.

Onondaga—The Onondaga is the lower formation of the Devonian system in the western Peninsula of Ontario. There are but two extensive quarries actually producing stone at the present time, both situated at St. Marys. The following areas may be established: Hagersville, Port Colborne, Buchville, St. Marys, Amherstburg, Pelee Island, and Kincardine. Although the extent of this formation is large, rock exposures are by no means common, as the country for the most part is deeply covered with soil. The most important quarries are around St. Marys, where a grey limestone of semi-crystalline character and good chiselling qualities is produced. On weathering it assumes a lighter color, but the whitening is never so pronounced as in the case of the Black River stone.



Montreal limestone—Martineau's Quarry, Mile End Group, Montreal.

Hamilton—Actual exposures of this formation are so interbedded with shales that profitable quarrying operations could only be effected with a brick and tile plant. Limestone may be obtained at various points along the Aux Sables River, in the vicinity of Thedford, and on the shore of Lake Huron.

Granites

Although gneiss and granite occur over wide areas in the Archaean region of Central Ontario, they have not been exploited to any great extent. The actual total production is insignificant and quite out of proportion to the possibilities of the country. The only present production of granite is from a region northwest of Gananoque, on the St. Lawrence. Gneiss has been obtained from North Bay, Gravenhurst and Parry Sound. With the granites are included the syenites which occur in abundance in Haliburton, Peterborough, and Hastings. With the exception of the St. Lawrence area, granite deposits have been worked little or not at all.

Crystalline Limestones and Marbles

In the southeast portion of Hastings, Lanark, Frontenac, Leeds, Haliburton, Renfrew, Peterborough and Victoria, are extensive belts of crystalline limestone. Roughly speaking, there is about 100 square miles of territory formed of rocks of this type. While most of the stone is too coarse and friable, or too impure for structural work, some of it, on the other hand, is so fine, and so beautifully marked as to deserve the name of marble.

QUEBEC

Limestones

The limestones quarried in the Province of Quebec for purposes of construction are obtained to a very large extent from the Chazy and Trenton formations. Beekmantown stone is employed locally, and the limestone of "Silurian" age in the peninsula of Gaspe is used in very limited amount. All the finer grades are derived from the Chazy and Trenton formations and are semi-crystalline, greyish stones in which the chief variation is the relative development of their dark-colored, argillaceous partings.

A second type is a more thinly bedded, less crystalline and much darker stone, suitable for rock-face work and common building. Beekmantown limestone, as developed in Quebec, is usually of poor color and does not represent possibilities beyond local application for foundations.

Chazy and Trenton—Owing to the similarity of the limestone, these two formations are considered together. The following geographic areas, certain of which are subdivided into districts, may be recognized: Montreal area, covering Caughnawaga district, Pointe Claire district, St. Laurent district, Bordeaux district, St. Martin district, St. Vincent de Paul district, St. Francois de Salles district, and the Montreal district which includes Villeray group, Mile End group, De Lorimier group, Iberville group, Nicolet group, Maisonneuve group, Cote St. Michel group, Lachine group; St. Johns—Grande Ligne area; St. Dominique area; Joliette area; St. Cuthbert area; St. Marc des Carrieres area; Grenville area; Hull area; Roberval area.

Beekmantown—The Beekmantown formation, formerly know as the calciferous, consists largely of brownish dolomitic limestones frequently with an admixture of sand. The stone is usually of a rough character and subject to rapid weathering. Good stone of this formation has been raised in Ontario, but the Quebec exposures are less satisfactory. This formation occurs south of Lake St. Louis in two wide areas, but despite its wide extent, the quarries in this formation in Quebec are insignificant.

Silurian System—Silurian limestones that have not yet been satisfactorily ascribed to formations are quarried at several widely scattered points in the province. The most important of these is the group of flagstone quarries in Wolfe County.

Sandstones

Sandstone of a quality suitable for structures of importance is of rare occurrence in the Province of Quebec, but more or less desirable stone has been raised from some six different formations. The nature of the stone is quite distinct in these different formations and is briefly mentioned below:—

Potsdam-Beekmantown—a hard, white sandstone, almost a quartzite in places, usually much disfigured with iron stains, adapted to rock-face work; Sillery—a hard, compact stone of greenish color, very solid and durable, but too hard and rough for fine work; Trenton—a coarse-grained, calcareous sandstone; Niagara—a coarse-grained, friable stone, subject to iron stains on weathering; Devonian—a fine-grained, homogeneous, reddish sandstone, by far the most desirable of the Quebec sandstones; Carboniferous—a coarse, friable type of olive-green, not comparable with the better varieties of Carboniferous sandstones of the Maritime Provinces.

Potsdam-Beekmantown—This formation is the oldest of the Palaeozoic series represented in the province. Its greatest development is in Vaudreuil, Soulanges, Two Mountains, Beauharnois, Chateauguay, and Huntington, whence it extends as a narrow band eastward along the Pre-Cambrian axis to the longitude of Three Rivers. A hard and durable sandstone exposed at numerous places, which has afforded an opportunity for numerous quarries for local building.

Sillery—The Sillery formation consists of a series of red and green shales with which are associated hard sandstones of varying colors. The formation has been so severely folded that the strata are now formed with vertical or highly inclined dips. It is developed east of the city of Quebec, on the Island of Orleans, and over a very extensive area which stretches from the south shore of the St. Lawrence below Quebec, to the international boundary. The sandstones have been seriously quarried only in the vicinity of Quebec and Levis. The stone is hard and not suited to fine carving, but it is very durable and retains its dark greenish color almost unaltered after years of exposure.

Trenton—The Trenton limestones on the north shore of the Lower St. Lawrence, are underlaid in places by a basal sandstone belonging to the same series as the Trenton limestones. Due to excellent shipping facilities extensive quarrying was carried on in the Malbaie area at Murray Bay. This sandstone from Murray Bay is of a high order of durability.

Devonian—The Devonian sandstones of Gaspe have frequently been referred to as a source of supply for building purposes. The inaccessible nature of the interior of the Gaspe Peninsula has prevented the exploitation of these stones. The stone is a very desirable material on account of the fineness of grain and the uniformity of color, which is very like that of the brown Credit Valley stone of Ontario.

Carboniferous—Sandstones of the Carboniferous formation which are so largely quarried in the Maritime Provinces, are sparingly developed at a few points along the north shore of the Baie de Chaleurs, in the Province of Quebec. The most important belt lies in the vicinity of Pointe a Bourdeau, opposite Campbellton, N.B.

Granites and Gneisses

True granites are composed of three mineral constituents—orthoclase feldspar, quartz, and mica, or some other ferro-magnesian mineral. When a rock of this nature presents a laminated structure with the constituents more or less distinctly arranged in layers, it is known as "gneiss." By a failure of the quartz constituent, granite passes into "syenite."

Granite and its allies, are quarried in two general regions which are very dissimilar geologically. The ancient Pre-Cambrian crystalline area of northern Quebec contains enormous ranges of granite and granitoid gneiss. In this area the following quarry areas may be established: Riviere a Pierre,, Roberval, Ottawa, Argenteuil, and St. Jerome.

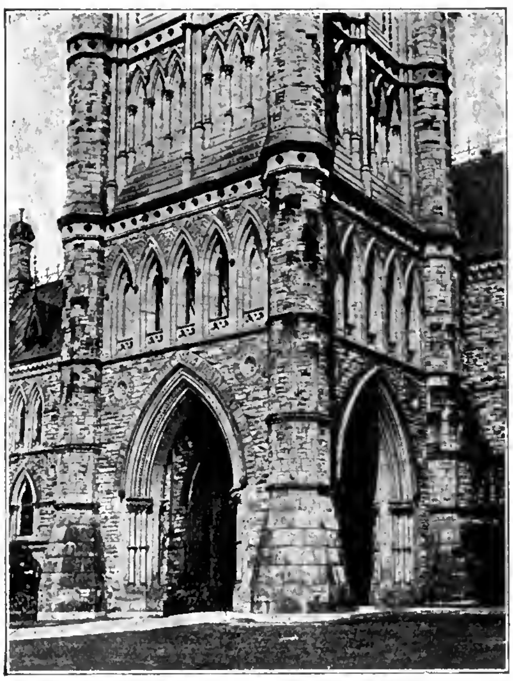
The second general region is in the southern part of the eastern townships where granite is quarried from igneous masses of later age than the surrounding sedimentaries. The important areas may be arranged as below: Stanstead, Magoons Point, Megantic, and Stanhope.

Black Granites

The term, "black granite," is used by quarrymen to designate the dark-colored, igneous rocks in general. The great majority are diorites, diabases, etc. The important sources of black granites in the Province of Quebec are the Monteregian Hills, a series of intrusive, igneous masses which broke through the Palaeozoic region in late Devonian or early Carboniferous time. The most important of these are: Montreal Mountain, Mount Johnson, Yamaska Mountain, and Sheffore, Brome, Boloeil, Rougemont, and Montarville mountains.

Marbles

The term, "marble," in the narrow sense is confined to crystalline varieties of limestone which have acquired their characteristic structure by the metamorphic action of natural agencies such as heat and pressure.



Nepean Sandstone—Main Entrance, Parliament Building, Ottawa.

Marble occurs under two general conditions in the Province of Quebec: first, in the form of bands in the great Pre-Cambrian region of the north and in the narrower Pre-Cambrian belts of the Eastern Townships; second, in the form of metamorphosed zones in the sedimentary limestones of the Palaeozoic and in the peninsula of Gaspe. The more important occurrences of these two types are: Pre-Cambrian marbles—in the Northern Quebec area (Portage du Fort, Pontiac County; Ste. Thecle, Champlain County), and in the Eastern Townships (South Stukely and Oxford Mountain); Palaeozoic marbles—St. Lin, Terrebonne County; Phillipsburg, Missisquoi County; Dudswell, Wolfe County; St. Joseph, Beauce County, and Port Daniel, Bonaventure County. The marble industry is gradually becoming an important factor in the development of the mineral resources of the province.

MARITIME PROVINCES

Sandstone

The various members of the Carboniferous system, which is so extensively developed in the Maritime Provinces, contain numerous beds of sandstone, of which no inconsiderable number are sufficiently homogeneous and of the requisite texture to yield excellent building material.

The rocks of this system, as developed in the Maritime Provinces, are usually classified as Upper, or Permo-Carboniferous, Middle Carboniferous, and Lower Carboniferous. While sandstone has been quarried from all the subdivisions, the Permo-Carboniferous and the Millstone Grit of the Middle Carboniferous, have yielded practically all the commercial output. These two formations will be considered together, using as a basis of classification the geographical areas, which are, beginning in the north of New Brunswick and continuing south and east to Capė Breton, more or less distinctly marked off into the following quarries: Chaleur Bay, N.B.; Miramichi, N.B.; Buctouche, N.B.; Shediac, N.B.; Fredericton, N.B.; Shepody Bay, N.B.; Cumberland Basin, N.B.; Wallace, N.S.; John River, N.S.; Pictou, N.S.; Monk Head, N.S.; Boularderie Island, Cape Breton; Sydney, N.S.; Whycocomagh, N.S.; Port Hood, N.S., and Prince Edward Island.

The sandstones from these various areas, while alike in some respects, show great variations in color, in texture, and in the character of the cementing material. In a broad way, they may be classified into two groups—olive-green and grey sandstones, and red and brown sandstones.

Areas producing only olive-green or grey stones are: Chaleur Bay, Miramichi, Wallace, Shediac, Pictou, Boularderie, and Sydney. Areas producing only red or brown: River John, Monk Head, Whycocomagh, Prince Edward Island. Areas producing both olive-green and red or brown stone: Buctouche, Fredericton, Shepody Bay, Cumberland Basin, and Port Hood.

In texture the olive-green and grey sandstones vary from fine to coarse, the finest grained examples occurring in Chaleur Bay, the Pictou and the Port Hood areas. The general average texture of the typical olive-green is rather coarse. Nearly all the stones can be carved and drilled with reasonable facility. The red and brown sandstones vary from a dirty brown to a very brilliant red. In texture the brown stones are decidedly coarse; the medium toned red from Sackville and Amherst are of medium grain, while the argillaceous red stones of a brighter hue from the River John and Inverness County, are of fine grain.

Granites

Extensive masses of granite, more or less suitable for construction, occur in several areas in both Nova Scotia and New Brunswick. In texture these granites vary from extremely coarse to very fine grained, and in color from bright red to a light grey. Notwithstanding the wide extent of the exposures and undoubted value of many of the granites, there are only five locations in which stone is being continuously quarried: St. George, N.B.—producing red, pink, and light grey, coarse grained, monumental stone; McAdam Junction, N.B.—a coarse grey stone for building only; Spoon Island, N.B.—a pinkish and greyish, medium grained, monumental and building stone; Metam, N.S.—a fine grained, grey, monumental and

Sackville Sandstone—Fireplace.

building stone; Halifax, N.S.—coarse grained to prophyritic, greyish, building stone.

The New Brunswick granites may be observed in the following areas: Bathurst, McAdam, St. George, Spoon Island, and St. Stephen. The Nova Scotia areas consist of: Nictaux, New Germany, Shelburne, Halifax, Greysborough, and Cape Breton. Several large masses of granite appear along the south-western boundary of New Brunswick, extend north and east and appear as isolated patches on the shore of Chaleur Bay.

Black Granites

Many of the dark-colored igneous rocks, such as diabase, diorite, gabbro, etc., are used for monumental purposes. The great toughness of this class of stone and the consequent difficulty of working, has restricted its use; but at present there seems to be a constantly increasing demand. The occurrences of these stones are numerous, but for the most part unimportant. Actual production is confined to a limited area near Bocabec, in Charlotte County, N.B. Rather excessive fracturing, together with the occasional presence of lighter colored stringers, and other blemishes, causes a large amount of waste.

Limestones

The Maritime Provinces are not rich in beds of limestone suitable for the purposes of construction and at the present time there is practically no commercial production for constructional purposes. Certain of the limestone beds have been worked in the past for lime making, the demand for flux in the iron furnaces of Sydney and New Glasgow having led to the opening of them.

Crystalline Limestones and Marble

The term "marble" is used here to indicate all calcareous stones of sufficient beauty to be employed for purposes of decorations. Ordinary limestones pass into marbles by the assumption of a crystalline structure or by the possession of agreeable and variegated colors, together with fineness of grain. In the Maritime Provinces, both types are represented—the former by the crystalline limestones of the "Pre-Cambrian" age, and the latter more particularly by metamorphosed beds of Carboniferous limestone. No marble of either type is now being quarried, but the crystalline stone is extensively used for lime burning and for flux. The crystalline stones are for the most part, coarse in grain and possessed of a strong banding with variations in color; they are largely quarried for lime burning at St. John, N.B., and for flux at Marble Mountain and George River, N.S.

Slate

Extensive areas of slate occur in both Nova Scotia and New Brunswick, in those regions where the clay sediments of Cambrian, Cambro-Silurian, and Devonian have been subjected to severe metamorphism.

Although slate is commonly regarded as a rough substance, it is nevertheless a very tender one, and is very susceptible to destruction under the action of water. There has, however, in spite of the extensive area, been no production for some years.

Montreal Rejects Engineers' Suggestions

By the casting vote of the Mayor, the Montreal Board of Control have rejected a motion calling for the appointment of Mr. J. G. Sullivan, engineer of the C.P.R., and Mr. A. St. Laurent, deputy minister and engineer in chief of the Public Works Department of the Dominion, acting in conjunction with Mr. P. Mercier, the chief engineer of the city, to study the aqueduct project, to give details of the estimated cost to carry out the scheme in its entirety, and of separate estimates for different branches, and to advise if the project might with advantage be modified or changed. The scheme has been the subject of much adverse criticism, and recently many prominent engineers petitioned the Controllers to appoint independent engineers to report on the proposed hydro-electric development portion, for obtaining 10,000 h.p. for pumping and lighting purposes. It was contended that the scheme had never been fully reported on and that there were doubts as to its economic value. The vote of the Controllers is a virtual rejection of this petition.

The Dominion Bridge Company will be asked to prepare plans for new headgates required for the enlarged Montreal aqueduct. The estimated cost is just over $100,000.

Machinery and Tools Used in the Stone Trade

Modern Steam and Electric Power Machines Now Utilized almost Universally—Rapid Developments in Recent Years

THE implements used in the stone industry consist essentially of hammers, chisels and drills, and when power is available, a number of special appliances which greatly reduce the cost of production.

Drills

Ordinary drills are made from steel bars of any desired length. The bit is made by drawing out the steel to a single sharp cutting edge a little wider than the steel, which is usually ¾ in. to ⅞ in. in diameter, although much heavier steel is occasionally used. Such drills are usually held and turned by one man, while another, or even two, strike with sledges. When power is available, machine drills are used. The machine rock drill has done more to render possible the excavation of rock on a large scale than any other appliance. The drill consists essentially of a cylinder in which the piston is driven down with the full force of the power available, whether steam or compressed air. Recovery is effected by the same agent. Drills are made varying in weight from 100 to 1,000 lbs., and are capable of sinking to depths up to 30 feet. The drills may be single bitted, but the cutting face is usually made either + or × shaped, and, as in hand drilling, smaller bits are used as the hole deepens.

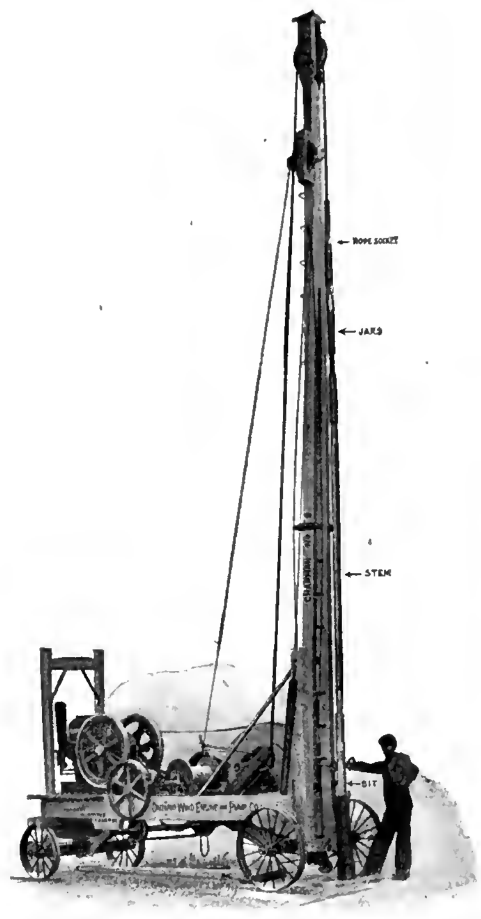
Rock drills are usually too heavy to handle without some support; and so they are mounted on some special contrivances to suit the work in hand. The most commonly used mount is the tripod with weighted legs. In order to drill a number of parallel holes along a straight line, the instrument is mounted on a "quarry bar," which consists essentially of a heavy bar of steel supported at each end by two adjustable legs. The drill is moved along this bar, which can be placed either in a horizontal or inclined position, by a rack and pinion. A lighter type of drill thus mounted is usually employed for horizontal holes made with the intention of "raising" a block. This operation is known as "gadding" and the instrument as a "gadder." In very hard rock, such as granite, where a channelling machine cannot be employed to advantage, channels are cut by the use of rock drills and quarry bars, the holes being drilled as closely as possible to present a minimum core area. Quarry bars are also used for gadding, usually with a light type of drill. Rock drills are commonly actuated either by steam or compressed air and in most cases are constructed to work equally well with either. More recent practice is to apply electricity to their operations.

Channelling Machines

A "channel" is a lineal cut of any desired length and of a depth up to about 15 feet. The width of the cut varies with the depth. Channels may be made with the rock drill and quarry bar. Instead of the rock drills, diamond boring machines travelling on an adjustable track are sometimes employed. The quarry bar and rock drill are still largely employed in granite quarrying, but for the softer stones—limestone, sandstone, and marble—the most modern direct-acting channelling machine is universally used.

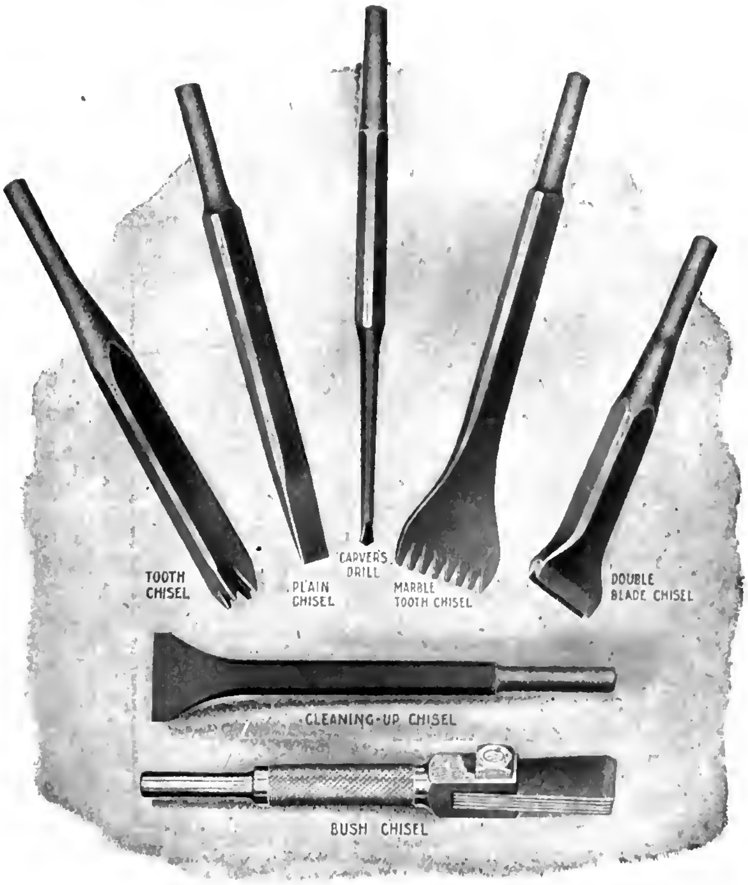
The channelling machine consists essentially of a truck travelling on rails and provided with a chopping engine capable of delivering powerful blows as the truck is moved slowly along the rails. By repeated trips back and forward the cut is sunk to the desired depth. The cutting apparatus consists of a gang of drills, usually five, attached by special mechanism to the end of the piston rod. The drills are made of rectangular steel and are bolted together in a line with the channel. The drills are single bitted, but the cutting edges are arranged in a special manner.

In quarries where the product is to be used for crushing only, a more expeditious machine known as the "Well Drill" is generally employed. This consists of an equipment essentially the same in construction and operation as a pile driver, except that the heavy hammer is replaced by a long and heavy iron bar several feet in length and up to 5 in. in diameter. The lower end of this bar is fitted with a steel chisel. Successive blows are accomplished just as with the pile driver by raising the bar to a considerable height and letting it drop. With this machine a much larger opening is obtained, which admits of a larger charge of explosive.

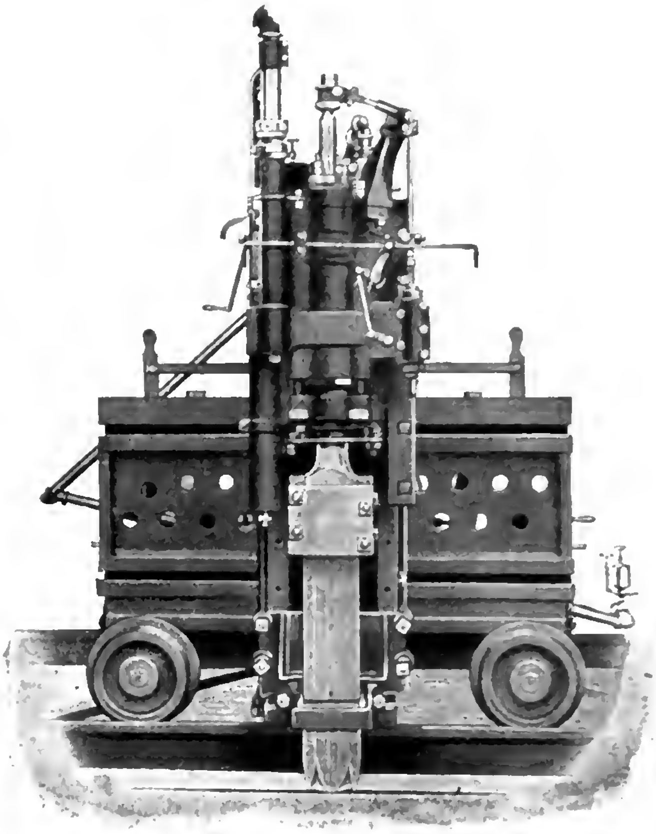


The Well Drill is a later Development.

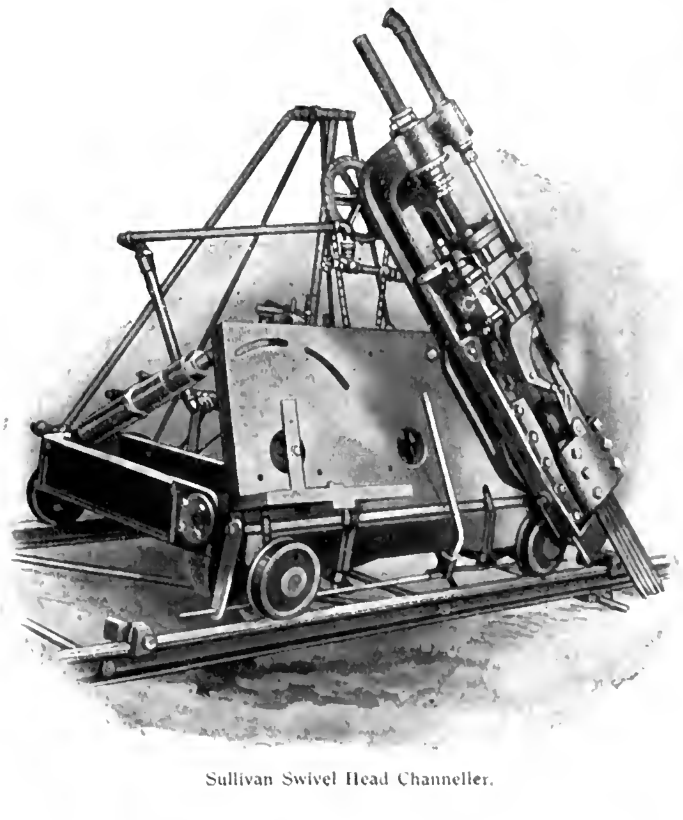
A new crushing plant has been installed by Walker Bros., Quarrymen and Contractors, of Thorold, Ont. Their quarries produce a very suitable stone for fluxing and for use in the manufacture of pulp.



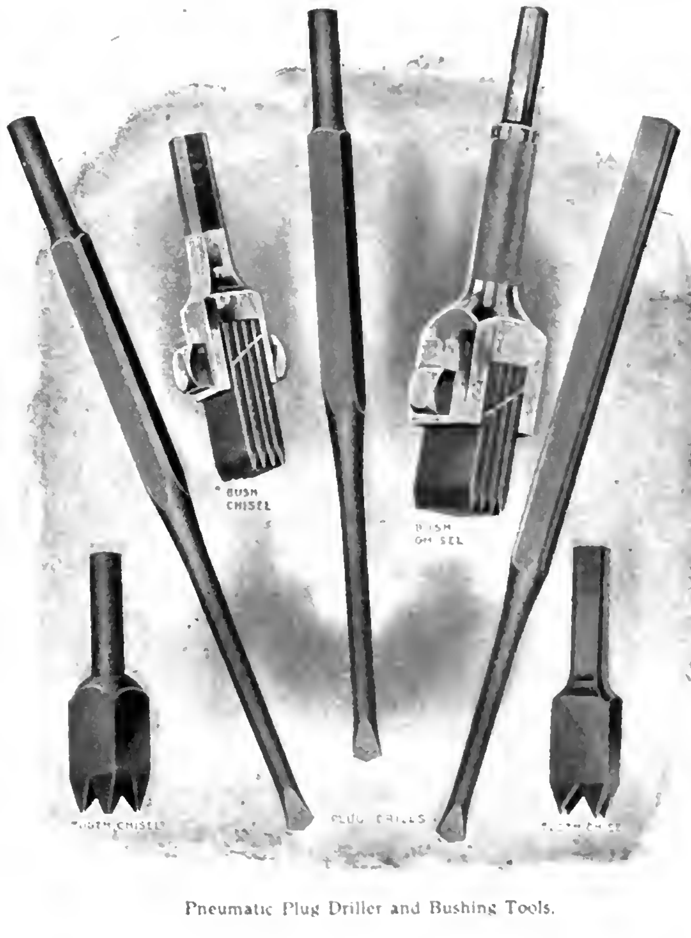
Chisels for Pneumatic Tool.



Ingersoll-Sergeant H9 Track Channeller.



Sullivan Swivel Head Channeller.



Pneumatic Plug Driller and Bushing Tools.

Tools for Dressing Stone

AS the stone industry advances, the use of machinery and its finer development is very distinctly apparent. We note briefly the main equipment of a modern dimension stone dressing plant below:—

Hammers

The hammers used for dressing stone vary in design and shape for special purposes. Hammers for surfacing stone are made with a series of pyramidal points on the faces. These points may be 4, 9, 16, 25, or 36 to the square inch. The stone is brought to a smooth plane finish by the successive use of finer and finer hammers. The difficulty of keeping these tools sharp has led to the use of an improved form in which the cutting face is made up of a series of sharp edges, being the end of a series of steel plates. These plates are known as "cuts," which are bolted together and rest against a hardened steel "gib." These hammers are called "bush" hammers.

Chisels

No detailed descriptions of chisels will be attempted here. In all large plants the use of hand chisels has been greatly lessened owing to the introduction of pneumatic tools. The following are the commoner types of hand chisels: plain chisel or drove, with a sharp, straight cutting edge; pitching chisel, with a sharp, rectangular cutting face, used for trimming stone to a line; pointed, a tool with a pyramidal point, used in producing point work; splitting; toothed, like an ordinary chisel, with cutting edge toothed.

The chief forms used in the pneumatic tool are: plain chisel; cleaning up chisel; carver's drill; tooth chisel, with one or more rows of chisel teeth; double blade chisel, and a bush chisel. The bush chisel is made on the same principle as the bush hammer.

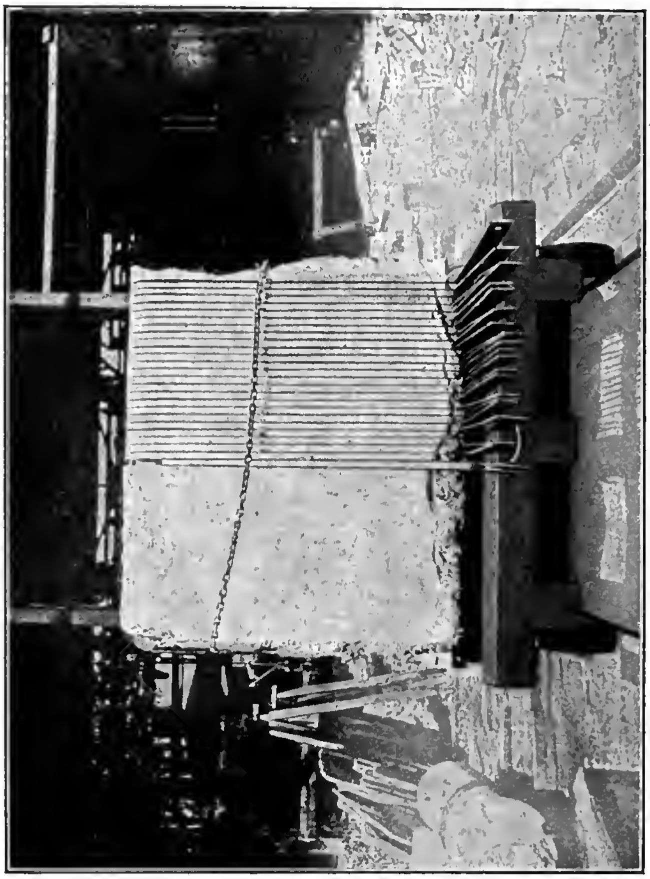
Gang Saw

The gang saw consists of a wood or steel frame with a horizontal steel sash suspended from the frame and free to swing. A reciprocating motion is given the sash by one or two pitman rods, which are driven by a crank. The frame is placed over a hopper-like opening which collects the water, sand, and stone dust as it flows from the saws.

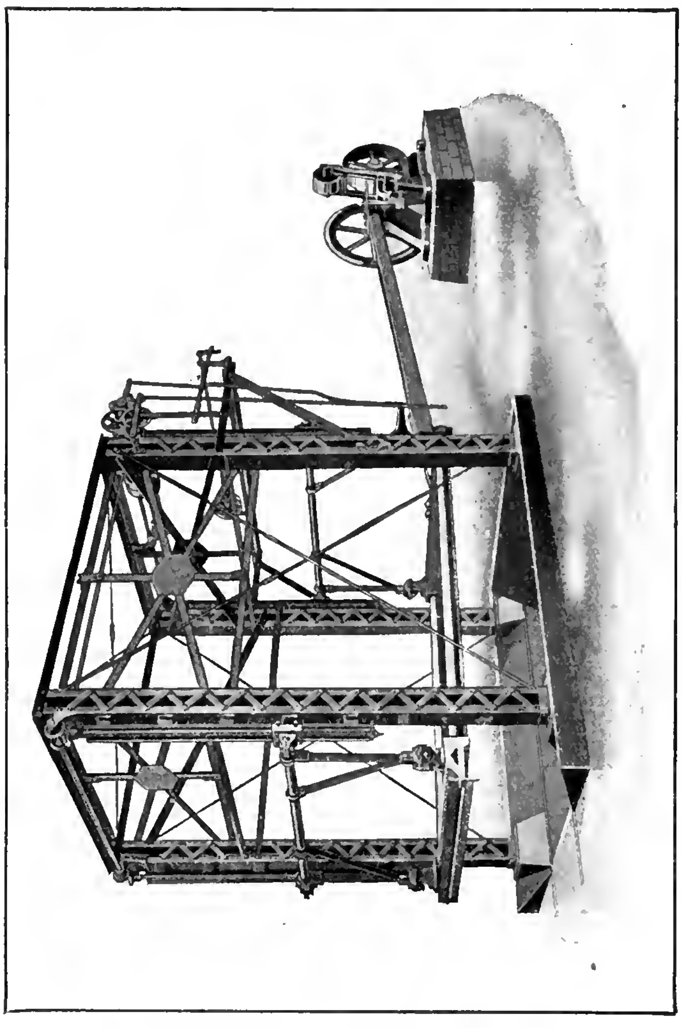
The actual saws, which are bands of soft steel, 3 in wide and ⅜ in. thick, are stretched between the head pieces of the sash and held in position by keys. They can be adjusted to cut to any desired spacing. The stone to be cut is placed over the hopper, beneath the sash, the saws adjusted, set in operation and a constant supply of water and sand fed over the stone by special distributers. The cutting is effected by the sharp sand which gets into the cuts and is ground between the saw blades and the stone. The overflow of sand and water falls into the hopper below the stone. This type of saw is used on limestones and marble On hard sandstone and granites the saw blades are heavier and are notched on the cutting edge; chilled shot or crushed steel is used instead of sand. Once started, the operation of a gang saw is automatic.

Rubbing bed

In smoothing the sawn blocks or slabs of the softer stones, the rubbing bed is used. This machine consists essentially of a round horizontal steel plate, which is given a rotary motion. The plates range



Block of Marble partly sawn into slabs on gang truck, with the saws left in place.



Patch Merriman Steel Frame Gang Saw.

from 4 feet to 14 feet in diameter, and run at about 45 r.p.m. The block of stone is placed face down on the rubbing bed, sand and water are supplied, and the stone left until sufficiently reduced. The finish produced by the rubbing bed is sufficient for outside work in marble and is known as the "sand finish."

Gritting and Polishing Machines

For further smoothing, the stone is taken from the rubbing beds to the gritting machines and thence to the polishers. These machines consist of horizontally rotating discs, to which different types of heads may be attached. These heads are blocks of abrasives arranged in a radial manner of different sizes with interspaces between them. The abrasives most generally used on the gritting machine are bricks of carborundum, of finer and finer grades as the polishing proceeds. Heads of black or Scotch hone are used for the final operation. The gritters run about 200 r.p.m. The polishers have heads of felt, usually about 20 in. in diameter, and operate at about 400 r.p.m. As in hand polishing, putty powder is used to produce the gloss.

Diamond Saw

The diamond saw is a rotating steel disc, with a number of carbons on its periphery. It is used for making single cuts for fitting together various pieces.

Planing Machine

Planing machines are devices whereby a block of stone may be moved to and fro on a horizontal bed, and at the same time be subjected to the cutting edges of chisels. These machines are very heavy and are usually driven by worm or screw gears.

Miscellaneous

Special drill machines, lathes for turning columns and other round work, counter-sinking machines, etc., are included in the dressing equipment, but their use is confined, in general, to the larger dressing plants.

Dressing Marble

Marble blocks from the quarries are shipped to the trade in the rough state or they are cut into finished articles by the producer. It is the practice of dressing companies to conduct this portion of their business in different mills, according to the use that is to be made of the finished product. Interior, exterior and monumental departments are recognized, but the operations differ in detail only.

The marble is first cut to the desired size by means of gang saws; if it is required to finish the sawn blocks or slabs with plane surfaces, they are moved next to the rubbing beds, where the surfaces are rendered quite flat. The final polishing is effected by treating the surface with abrasives of gradually increasing degrees of fineness. In hand polishing, five substances are successively employed, as follows: (1) coarse sandstone from Ohio; (2) blue grit from Nova Scotia; (3) red grit from Nova Scotia; (4) pumice; (5) hone.

Hones are of different kinds, the commonest being the Scotch hone or black hone; these are both fine grained shales. The final gloss is given by putty powder (oxide of zinc). Oxalic acid is also used if the marble is free from flint, and the time required to raise the gloss with putty powder is thereby much reduced. Oxalic acid cannot be employed with marble in which there are any hard streaks, as the corrosion

Turning a 45-ton block of Marble, Proctor, Vt.

or burning of the marble causes the harder material to stand out in relief. While hand polishing must still be employed for all marble objects of complicated design, it is superseded by the gritting and polishing machines for plane work.

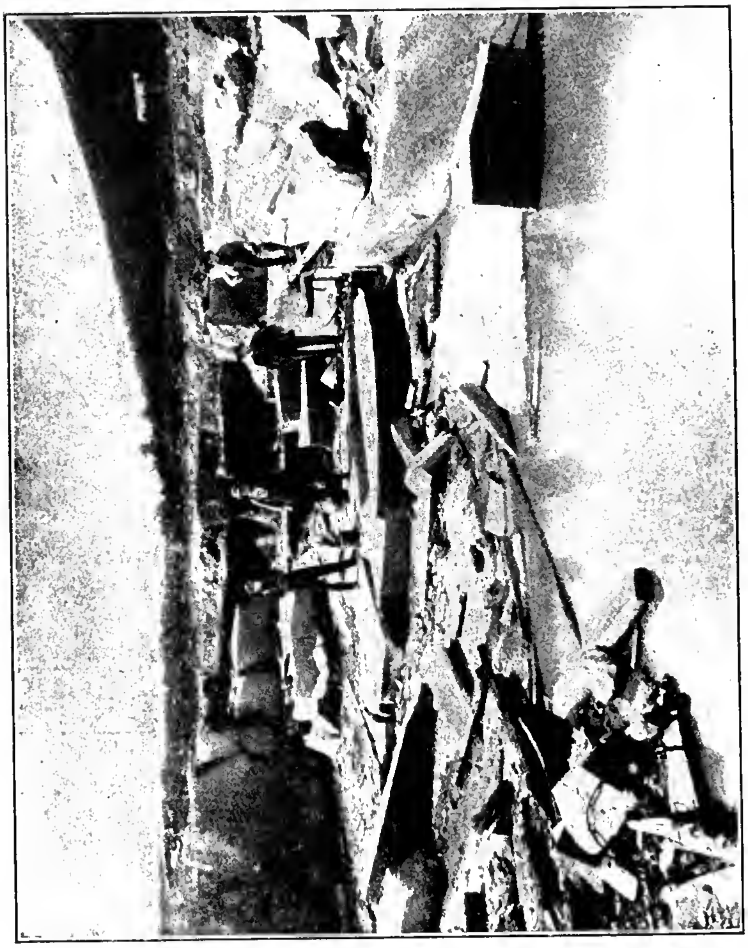
Wm. Britnell, Sommerville, Victoria County

The stone quarries of Wm. Britnell, 1127½ Yonge Street, Toronto, occupy about 9 acres at Sommerville, Victoria County, Ontario. An extensive opening discloses successive beds of solid blue limestone, grey and red limestone, and shales, to a depth of about 15 feet.

About 34 in. of the upper layers consist of a light brownish grey stone, fine grained and almost lithographic in character. On the whole, it is a fairly uniform, compact and durable stone. Lower down occurs a 6-in. layer which is partly fine grained and lithographic, but it is so filled with calcite crystals that it presents a more irregular surface on weathering. It has, however, a rather more desirable color than the upper stone.

Near the lower part of the bed is a layer of hard, red limestone which, when polished, presents an extremely attractive appearance. These red stones are very hard and have been used for rougher purposes on account of the difficulty of chiselling, but present splendid possibilities as a valuable decorative material. Most of the product of this quarry is converted into crushed stone, but building stone is shipped from time to time. The quarry is equipped with derricks, steam drills, etc., besides a thoroughly up to date crushing plant.

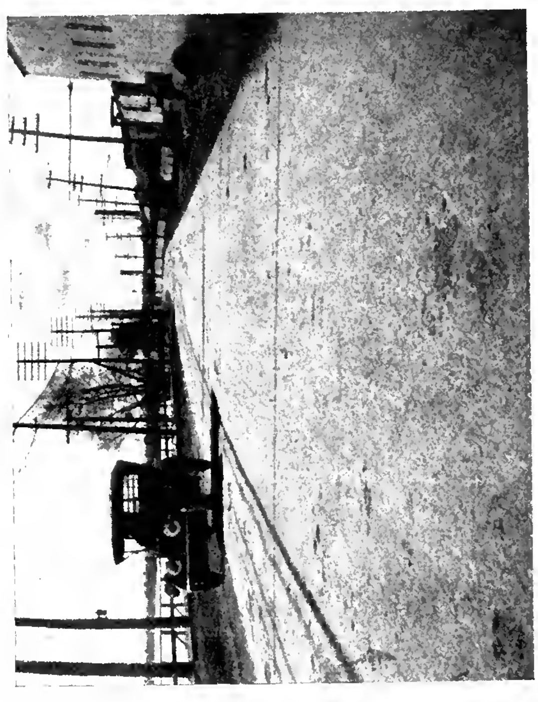
Uniformity in building codes is a very desirable feature that has had a pronounced exploitation by the leading technical societies recently. The application of building codes, although practised for ages, is just beginning to be worked into intelligent shape.



Megantic granite. Quarry of Lacombe and D'Allaire, St. Sebastien, Que.

Block of Sackville Sandstone—Sackville Freestone Quarries.

Miramichi Sandstone. Adam Hill's Quarry, near Newcastle, N. B.



Lake Shore Road where Ontario Trap Rock was used.

The Benching Method of Quarrying Rock

IN the bench method of quarrying the face is worked in one or a series of regular steps or benches, the height of the benches being governed by the thickness of the ledges and the location of the natural seams. Benches may vary from a few feet up to 20 feet or more in height but the most common run from 12 to 16 feet high.

In this method of working, percussion drills driven by steam or air and commonly called tripod drills, are usually employed. Tripod drills, up to about seven years ago, were in general use in quarries, but are now being rapidly displaced by the blast-hole cable drills where these are adapted. Tripod drilling and benching is best adapted where the face is not high enough to permit or where natural conditions exist which prevent the economical working of a well drill.

Occasionally even in quarries of high face where other conditions are favorable to use a well drill, the chemical content of the stone may vary so much, making it necessary to sort the material, that tripod drilling and short benching are compulsory. This may happen where stone is used for cement manufacture where it must be sorted to get the proper mix or in stone used for fluxing purposes.

In Tripod Drilling

In tripod drilling it is necessary to change steels or bits for every two feet of hole drilled. To facilitate drilling and prevent sticking it is customary to drop the gauge at least one-eighth of an inch for every change of steel. So that in drilling a 16-ft. hole, for instance, seven changes are made, and the finishing bit is seven-eighths of an inch less in diameter than the starting bit. We have then a tapered hole, smaller at the bottom than at the top. As a rule the bottoms are the hardest to pull, and from an explosive standpoint these holes are, we might say, upside down, and it is often impossible to concentrate enough explosive in the bottom to pull the bench cleanly. For this reason one often has to resort to springing or chambering, if the rock will stand it. If the ground will not stand springing often two or three divergent holes are drilled from one set up of the drill to permit more explosive being used. This, of course, greatly increases the drilling cost per ton of stone. Oftentimes a customer complains that an explosive is weak and does not pull bottom, when perhaps the trouble is that the holes are spaced too far apart or the finishing bit is too small. It is cheaper, as a rule, to spread the gauge of the drills than to jump from a forty per cent. to a sixty per cent. explosive to gain the same end. Take for example, a case where 16-ft. holes are drilled, starting bit 2 ins. in diameter. This means a 1⅛ in. finishing bit. Chances are 1¼ x 8 in. dynamite is used, and if so they do not get the powder to bottom of holes. Assuming they do, however, it is possible to get only about one pound of dynamite in the bottom two feet of hole. If the starting bit were increased to, say, 2¾ in., the finishing bit would be 1⅞ in. diameter, and about three pounds of dynamite could be loaded in the bottom two feet. It is evident, then, that this is a question deserving of consideration when selecting an explosive for a piece of work.

In spacing holes a great deal depends on the character of the material, direction of the strata and the purpose for which stone is used. If the stone lies flat a normal spacing for a 16-ft. hole is 8 ft. x 8 ft. in most material with unsprung holes. A 16-ft. hole should be loaded half its depth, at least, with explosive. If stone is pitching and is worked with the pitch the spacing may be increased. The heavier the pitch, the farther back the holes can be set. In a case like this it is usually only necessary to start the stone sliding to clear the bench. In experience it has been found best to use a quick and light explosive like extra or straight dynamite rather than a gelatin dynamite, because it is necessary to hit the stone as hard and as quickly as possible to insure maximum breakage before the sliding has commenced. Concentration is not desired, but distribution and a dense explosive would be found more expensive than a granular dynamite.

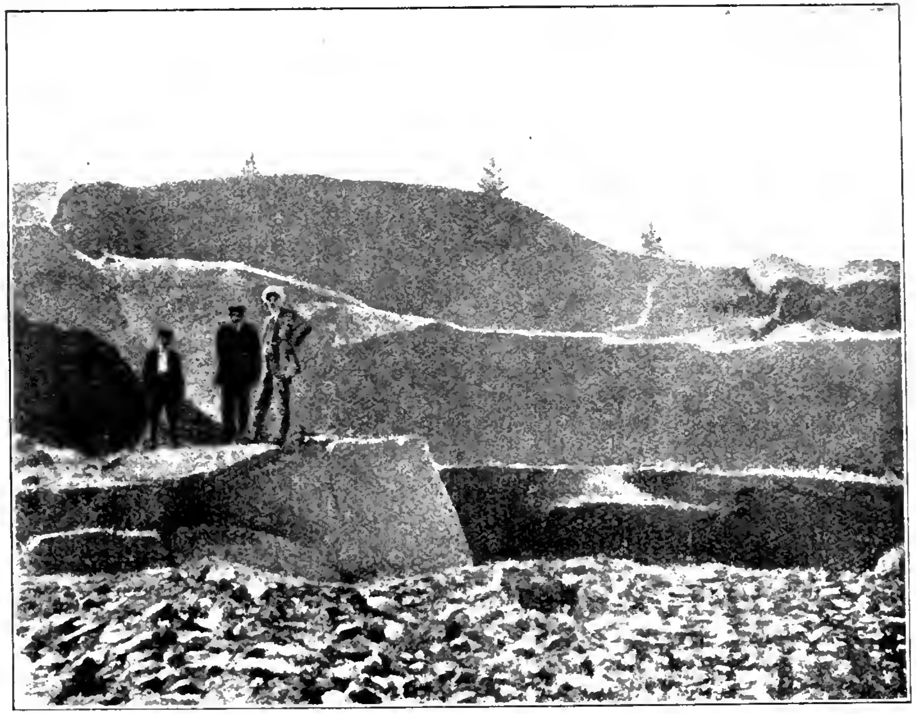
Working Against the Pitch

If the stone is worked against the pitch it is evident that the explosive has to lift the stone up and push it over the edge to clear the bench. In this case it may be necessary to spring the holes if possible, or space more closely or resort to divergent drilling. Also probably best results would be obtained by using a dense explosive like gelatin if holes were not sprung. The use to which a stone is put has an important bearing on the explosive question. If stone is used for lime burning it is not desired to break it up too much as spawls are usually wasted in quarries of this kind. Therefore, a slower explosive should be used, such as Red Cross ammonia. If stone is used for cement manufacture or crushed for commercial purposes a quicker explosive should be used or holes spaced so as to obtain maximum breakage in the initial shot. Except in very tough and hard material it will seldom be found necessary to use an explosive of greater strength than forty per cent. In some of the traps and granites a sixty per cent. explosive is necessary. In the bench method of working and tripod drilling a great item of cost is bench cleaning. In winter this is more expensive than in summer. Effort should be made to arrange the spacing of holes and select the proper explosive so that the bench can be cleared on the initial blast. It may be necessary to experiment for a while with different spacings and various explosives in order to arrive at the most economical method of obtaining this result. In most quarries where tripod drilling is practised, the stone is loaded by hand. If so, it is necessary to have as much of the stone one man size down in the initial blast as possible. In any case this is always desired, even if a steam shovel is used, as it means then maximum efficiency for the shovel.

Development of Lighter Drills

During the last few years there have been developed smaller, lighter drills of the "jack hammer" and "bull moose" types. These drills are self rotating, easily operated and hollow steel is used for bits. They work best with air but can be operated with steam power. They are very fast drills and 200 feet to 250 feet of hole per day can be made in straight continuous work. The jack hammer weighing less than fifty pounds is used mainly for block holing and secondary drilling but occasionally in bench work. The "bull moose" weighs about 90 pounds and is better adapted for heavier work. Only one man is required to operate either drill.

Kingsey slate. Old quarry on St Francis river, near Trenholm, Que.



Roberval granite. Bernier's quarry, Roberval, Que.

Raising a block of marble by shims and wedges.

Sackville sandstone blocks ready for shipment—Sackville Freestone Co.

Grindstone Quarries of the Maritime Provinces

A number of quarries in New Brunswick and Nova Scotia are given over very largely to the manufacture of grindstones. The chief of these quarries is as follows: at Stonehaven, Gloucester County, N.B., owned by the Read Stone Company; the Micmac Grindstone Co., Limited, near Woodburn, N.S.; the Dorchester Stone Works, near Dorchester, N.B., and the Miramichi Quarry Co., Quarryville, N.B.—the latter quarry

The Grindstone Yard of the Read Stone Co., Stonehaven, N.B.

also produces a considerable quantity of building stone.

Of the above mentioned grindstone quarries, much the largest is that of the Read Stone Company. This quarry produces grindstones of every required size, varying from 8 in. in diameter and 1 in. to 2 in. thick, to 7 ft. in diameter x 14 in. thick. This latter size weighs approximately 3¼ tons. Probably the majority of the grindstones required in Canada are produced from the Stonehaven plant, and large numbers are exported to the eastern United States, and in smaller quantities to other countries.

This quarry has been controlled by the Read family for over one hundred years, the original owners being Joseph Read and John Seaman, who acquired control about 1815. The Read brothers now operating these plants at Stonehaven and Wood Point, are the great grandsons of the original owners. The Read Stone Company are at present testing out a new property at Quarryville.

The Dorchester Stone Works, the next most active grindstone quarry in Canada, began operations in 1908 and has been operating on a small scale since that date. They have a plant consisting of a 35 h.p. boiler, engine, 4 ton steam hoist, turning lathe, steam drill, derrick, etc. Axe and pulp grinding stones are both turned out. The property consists of over 1,000 acres. The stone has always been used to a considerable extent for foundations, but it is the intention of the company to cater to the pulp stone trade almost exclusively. This plant is well situated on the Petitcodiac River within easy reach of the shipping wharf. F. C. Palmer, of Dorchester, is president of the company.

Quarries of Pictou County, Nova Scotia

By R. E. Chambers

THE northern part of Pictou County is occupied by Carboniferous and Permian strata, dipping for the most part northwardly under the waters of the Gulf of St. Lawrence and Northumberland Strait. In the upper part of these formations are many beds of sandstones which in the past have produced large quantities of building stone and grindstones. The building stones were formerly, and the grindstones are now, exported to the United States, in addition to home consumption. Many of the buildings of Halifax have been constructed of this material. The district may be divided into three sections, viz.: Merigomish, Pictou Harbor, and River John.

Merigomish

It is at Merigomish that the greatest quantity of grindstones have been produced. On Quarry Island, in Merigomish harbor, is the quarry which has been most extensively worked. The grindstones produced have been of excellent quality and large size. The dip of the strata necessitating more pumping, this quarry has been worked on a small scale only during the last few years, but it is said by the owner that a moderate expenditure for pumping and other machinery would again put it on a large producing basis.

At the west end of Merigomish Harbor grindstones have been quarried on the mainland for several years. These are hauled to the Intercolonial Railway and shipped to the United States.

Pictou Harbor

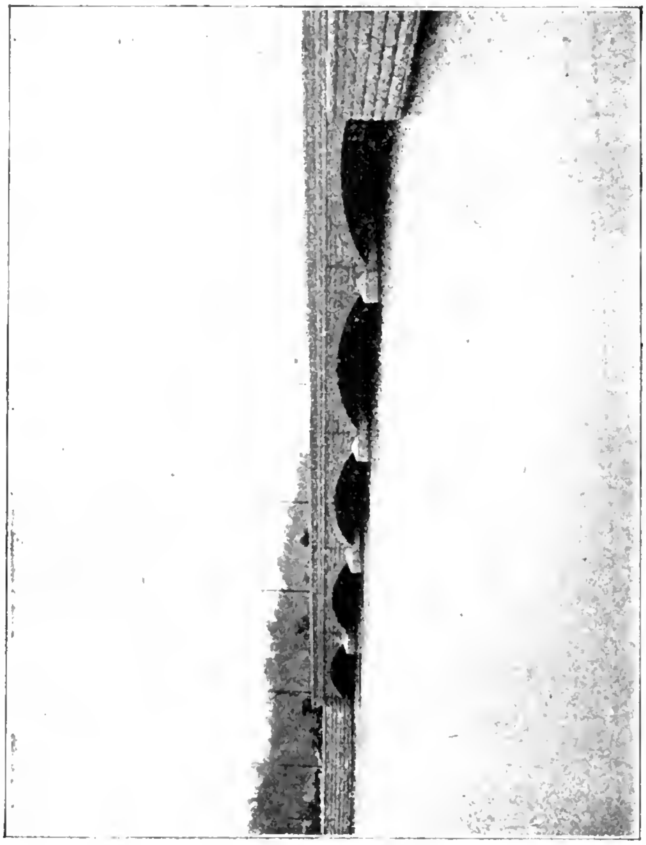
At various points on Pictou Harbor freestones of good quality were quarried for many years. The earliest workings were at Sawmill Brook, about four miles from the town of Pictou. Here a shipping pier was constructed about a mile from the quarries. The stone is moderately hard, the color being gray of various shades. No work has been done at these quarries for many years.

About two miles from the town of Pictou and one mile from Pictou Harbor, is a quarry which has produced a large quantity of freestone. This was worked by the Pictou Quarries Company, but is not now operating. The stone is easily cut, being light gray in color and occurring in beds of considerable thickness.

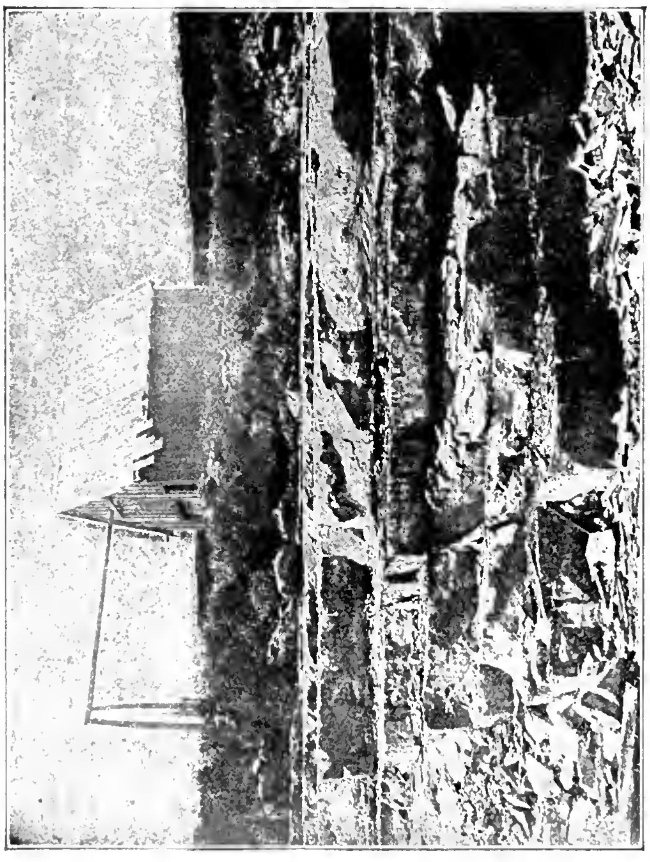
The shipments were made by a siding connected with the Intercolonial Railway at Pictou, and by a wharf on Pictou Harbor. Shipments were formerly made to the United States, and more recently to the various towns in Nova Scotia. The Bank of Nova Scotia at New Glasgow, is constructed of this stone.

Some years ago the Granton quarry was opened at Granton, near the Middle River. The stone was used for railway construction on the Short Line and Pictou branches, then being constructed. They were also

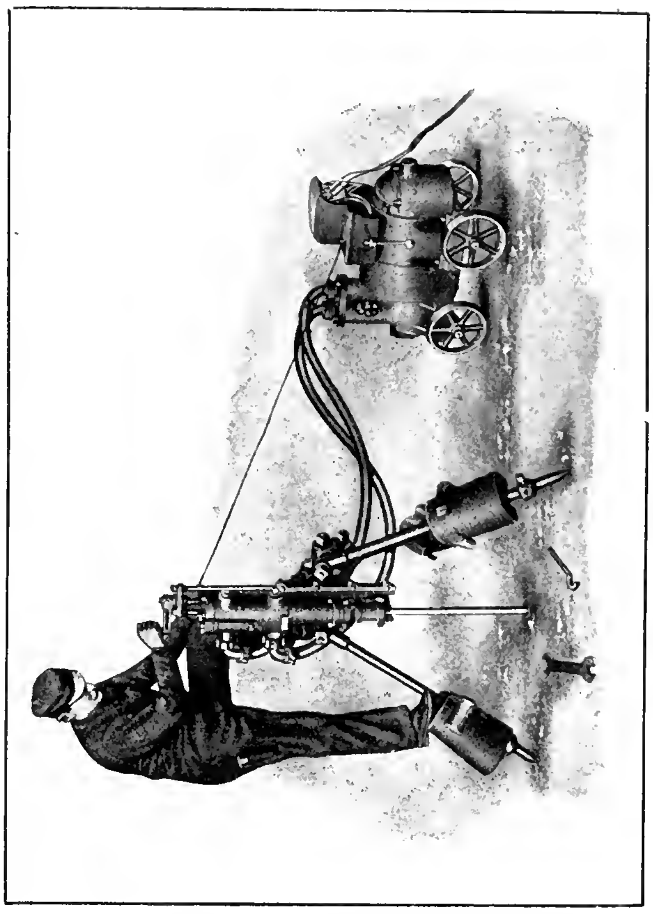
St. George granite. Milne & Coutts' quarries, St. George, N.B.



Queenston Limestone. Electric railway bridge over the intake, Canadian Power Co., Niagara Falls, Ont.



Level Upper Beds, Longford Quarries, Longford Mills, Ont.



Electric Air Rock Drill.

shipped to Halifax for building work, and grindstones were shipped to the New England States. The stone is light gray in color, easily cut, and free from iron stain. The grindstones produced were of excellent quality.

River John District

In the western part of the County the Permian strata contain some beds of fine grained red sandstone which have been rather extensively quarried. Near the village of River John shipments have been made from the Roger's Farm and from near the crossing of the river by the Intercolonial Railway, and on the Strait shore they have been worked on the Henderson farms. The stone is reddish brown in color, fine grained and easily cut. Considerable quantities have been shipped to Toronto for building purposes. They resemble in color the Credit Valley red sandstones, but are much softer in texture.

The stone in the New Glasgow post office and other buildings there are from this district.

Limestones

Underlying the true carboniferous strata of this county, which produces from many thick seams its large output of coal, there are extensive exposures of the Lower Carboniferous Marine Limestone formation containing beds of limestone of good quality.

The blast furnace of the Nova Scotia Steel & Coal Co. was formerly operated at Ferrona, and during this period extensive quarries of limestone were operated as Springville and at Black Rock, on the East River, for this furnace. The quality is fairly good, analysing about 93 per cent. in carbonates of lime and magnesia. In addition to these, quarries were opened on a small scale at various points for local purposes.

Trap Rock

An extensive quarry is operated at Black Rock, on the East River, by the Pictou County Contractors' Supply Co. Elaborate tests have shown this stone to be of exceptional hardness and durability, making it very desirable for road metal and for concrete purposes. The quarry is equipped with rock breaker, screens, bins, etc., and is extensively worked. Shipments are made over the Intercolonial Railway. The stone has been extensively used for street pavements in the town of New Glasgow, and for concrete structures at the many works located there.

Roger Miller & Co., who have the contract for constructing the Carleton Point end of the car ferry connecting the main land with Prince Edward Island, have a three years' lease of the quarry of E. A. Smith, Shediac, N.B. The quarry contains a freestone of a light olive shade, which is fine in texture, easily worked when green, and capable of taking the finest tool work. It becomes very hard when weathered, but splits beautifully, according to the owner of the plant. Stone from this quarry has been furnished for several buildings in the city of St. John and Fredericton, also for the Telegraph Building in the city of Quebec. The Miller lease expires with the present season.

The Thames Quarry Company, Limited, St. Marys, Ont., have just reopened their quarries for this season. Their principal product is crushed stone for roadmaking and concrete work, although they get out considerable building stone such as rubble and coursing stone, as well as some dressed stone. This company also manufacture pressed brick made from ground limestone and cement; these are cured in steam kilns.

Why We Use U. S. Stone

By a Cut Stone Contractor

The quarrying and stone cutting industry throughout the Dominion has made rapid progress in the last twenty years; this is especially true of the stone cutting section, but there still remains much to be done so far as the quarrying end is concerned. There are several reasons why Canada uses such quantities of imported stone. First, and principally, cost; second, architectural features desired by architect or client regarding color schemes; third, imported stones now in use are more adapted to machine work, thereby cheapening production; fourth, practically unlimited resources regarding supply and shipment of same.

Regarding the cost of rough quarry blocks, several items have to be considered, included the soundness of stone, the shape in which it comes from the quarry, and the time and quantity for delivery. The imported rough quarry blocks usually come squared up in excellent shape, ready for cutting up for the finished product, and the waste is reduced to a minimum thereby, whereas the usual Canadian quarries are handicapped in not having and using up to date quarrying apparatus. I am drawing attention to these points as the reasons for so much imported stone being used. The cut stone contractors have also to pay more for Canadian stone at the quarry than they do for United States stone at the quarry.

To improve conditions to meet the foreign competition—I refer now more especially to the Province of Quebec—additional capital is required to exploit the quarries. Larger sums will have to be spent in purchasing better machinery. In the United States the quarries are equipped with the most modern machines, enabling them to produce rough building blocks at a minimum cost, and to reduce their overhead charges by reason of the immense quantities shipped out. There is also this fact to be taken into account—more up to date equipment will mean that Canadian quarry owners will be able to produce stone in a far better condition for the cut stone contractors to handle, thus saving the large amount of waste at the finishing yards, which are usually located some distance from the quarries. I desire to lay emphasis on this point, as the waste is a very important factor in the price which the consumer has to pay.

In obtaining a better class of stone the cut stone contractor will save an appreciable amount in freight charges on rough quarry blocks. At the present time, owing to the condition in which the blocks leave the quarries, a considerable sum is unnecessarily spent in the freight of material which is absolutely worthless as building stone. The blocks have to be squared up, and the resulting waste on which freight has been paid cannot be disposed of to even cover the cost of that freight.

United States quarries will turn out stone exactly to our specifications, whereas we are not at all certain as to the sizes which will be supplied by many Canadian quarry owners.

As regards color, it is impossible to obtain in Canada many of the colors we require, and we are therefore bound to import from elsewhere.

The D. Robertson & Co., Ltd., Milton, Ont., quarry all kinds of Credit Valley grey sandstone, such as rubble, dimension blocks, coursing, sills, lintels, verandah caps, etc. They do all kinds of dressing at the quarry. This company also have lime kilns and burn what is known as Milton grey lime.

The Sackville Freestone Quarries, N.B.

The Most Important Producer in the Maritime Provinces—Operations Carried on with Most Modern Machinery and Business Methods

THE quarry of the Sackville Freestone Company, Ltd., which is located close to the town of Sackville, N.B., must be regarded as the most important producer of building stone in the Maritime Provinces. This property at Sackville was opened up a number of years ago by Mr. Charles Pickard on his farm, and later taken over by the Sackville Freestone Company, Limited, of which Mr. Pickard is manager.

The quarry is situated a short distance from the main line of the Intercolonial Railway, and covers about 50 acres of the company's property. The quarry proper is about 200 ft. square and 60 ft. deep. The upper 20 ft. is soil, beneath which is 40 ft. of red sandstone in beds up to 5 ft. thick. The various layers are horizontal and are remarkably continuous, with scarcely any of the lenticular bedding so common in the sandstone quarries of the Maritime Provinces. The isolated formation of the rock deposit is unique in the respect that it is entirely local and

Blocks of Sackville Freestone—See other pages for further illustrations of this Quarry.

altogether different from the other deposits in the country, being very even in color and quality and of a much finer grain than the surrounding stones, which are coarse, uneven and soft, for the most part.

The rock probably belongs to the Permo-Carboniferous age and presents a subdued red appearance in color. Under corrosion there is little, if any, change in color and but a slight loss in weight. The quartz grains are for the most part sharply angular and of a variable size. Feldspar and mica flakes are scattered through the rock.

The following are the principal physical characteristics of the stone: specific gravity, 2.711; weight per cubic foot, 145.743 lbs.; pore space, 13.882 per cent.; transverse strength, 1,016 lbs.; crushing strength, 11,889 lbs.

The red Sackville stone is used largely throughout the eastern part of the Dominion, and, notwithstanding the freight charges, is able to compete successfully with other stones for buildings of the best type in Ontario.

Among the many structures in which the Sackville stone has been used, the following may be mentioned: Royal Bank, Sackville; Bank of Montreal, Moncton, N.B.; Observatory, Ottawa; new wing of Parliament Buildings, Toronto, etc.

While the Sackville Freestone Company have an asset in this stone, which has undoubtedly been proven one of the best of the kind in the country, it is not on this alone that the success of the company depends. The up-to-date methods of handling the stone in the quarry, and the business-like way in which the industry has been conducted, have also been important factors. The company have installed an up-to-date plant and are planning for further extension of the facilities already provided. The equipment may be summarized as follows:—

Four 20 ton derricks, operated by one large engine and boiler, and one small engine and boiler; two steam drills; two Patch gang saws, operated by electricity, which is also used for one of the derricks; a steam shovel for handling overburden, and a 15 ton Brown hoist locomotive crane. The mill is placed close to the quarry and is so arranged that a minimum of handling is necessary. A spur branch about 1½ miles long from the Tormentine branch of the Intercolonial Railway affords good shipping facilities. About 25 men are employed by the company.

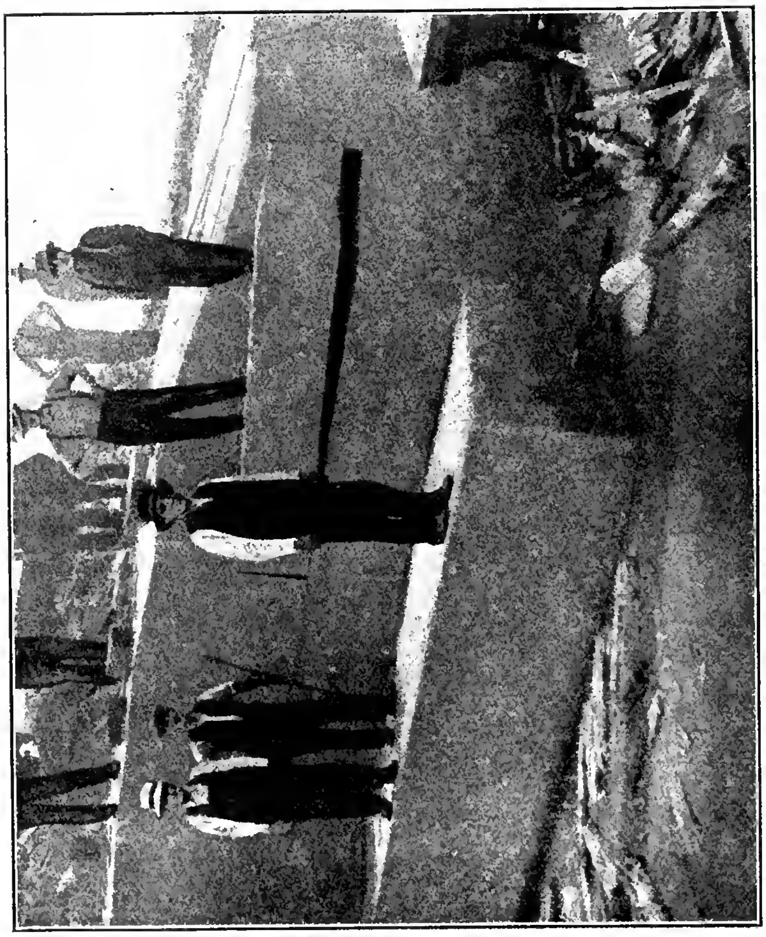
The total output of the quarry is from 8,000 to 10,000 per annum, all of which is used for building stone. As indicative of the favor with which this stone is being received in Ontario, it is worthy of note than it is enjoying an increasing sale in Hamilton, London, St. Thomas, Chatham, and many other towns in Western Ontario.

The firm has a reputation among contractors of being business-like in every sense of the word. No work is undertaken that cannot be completed, and contractors are not delayed by the tardy execution of orders.

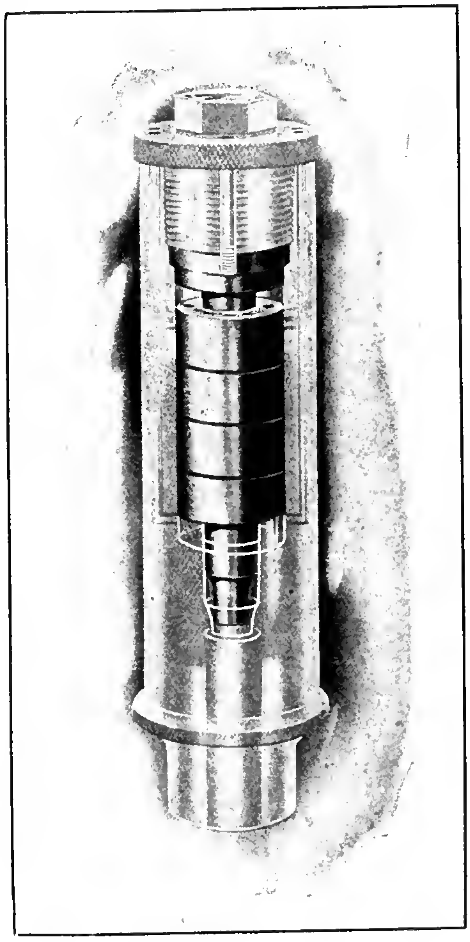
Armstrong-Whitworth Extensions

John Quinlan and Company, Westmount, P.Q., have obtained a contract for doubling the plant, at Longueuil, of Armstrong Whitworth of Canada, Limited, of which Mr. M. J. Butler, C.M.G., is managing director. The floor space will be increased from 50,000 to 100,000 square feet, and a new structure and office building will also be erected. The new plant of steel and concrete, includes units for the manufacture of steel tires for locomotives and passenger rolling stock, the rolling of steel wheels, and the manufacture of forged axles. A rolling mill will be installed, and provision made for making special rounds and shapes for electric smelted steel. The contract for the steel work of the extension has been let to the Dominion Bridge Company. The total cost will be about $750,000.

Red Sandstone from quarries of Sackville Freestone Company, Limited, Sackville, N.B.



Stanstead Granite, Norton's Quarry, Graniteville, Que.



Pneumatic Tool used in Quarrying

Matched Slabs of Marble, Ontario Marble Company, Bancroft, Ont.

An Up-to-date Stone Crushing Plant

The buildings of Crushed Stone Limited are new and the equipment powerful and modern — A rapidly developed business

ONE of the most modern crushed stone plants, and one of the largest, though possibly not the largest in Canada, is that of Crushed Stone, Limited, of Kirkfield, Ont. At the present time this company is opening a new quarry close to the Trent Valley Canal and in the immediate vicinity of their new crushing plant, built in 1914, as illustrated in one of our accompanying photographs. This quarry is being opened up to an 18 ft. surface. One of the illustrations also shows a new steam shovel just installed by this company, a hundred ton Bucyrus, equipped with a five-yard capacity dipper. This shovel will dig 2,500 tons of stone per day and is thus easily the equivalent of 100 men. It is one of the largest, if not the largest, at present operating in the Dominion. An auxiliary shovel of 1,500 tons' capacity, is also in use by the company.

Plant of Crushed Stone Co., Ltd., Kirkfield, Ont.

Particular interest centres round the operation of the crushing plant. Fig. 1 illustrates the various phases of the necessary operations. That part of the building marked "A," contains the crusher. The stone coming from the quarry is shunted on the track, shown in the right hand side of the picture, by a donkey engine, and drawn up the incline by a steam operated cable. The stone is here dumped into the crusher and the car returns by gravity to the level surface. A loaded and empty car are seen in the picture, one ready to ascend, the other just returned from the crusher shed. Two crushers are installed, a No. 7½ and a No. 5, so that the capacity of the plant is approximately 1,000 tons per ten-hour day.

From this point the crushed stone is elevated into "B," thence passes to "C" for screening, and, by gravity, to graded bins in "D," from which it is loaded, also by gravity, into railway cars, which pass beneath "D, and one of which may be seen in the picture.

15 Ton Locomotive Crane.

The gradations in the screening house have been carefully adjusted and at least seven grades of stone are always available. These are what is known as stone dust, grit, ⅜ in., ¾ in., 1¼ in., 2 in., and approximately 4 in. Grit is becoming increasingly useful in making country roads, where it is valuable for filling up the interstices between the larger pieces of stone. It is also used to a considerable extent in the manufacture of cement block.

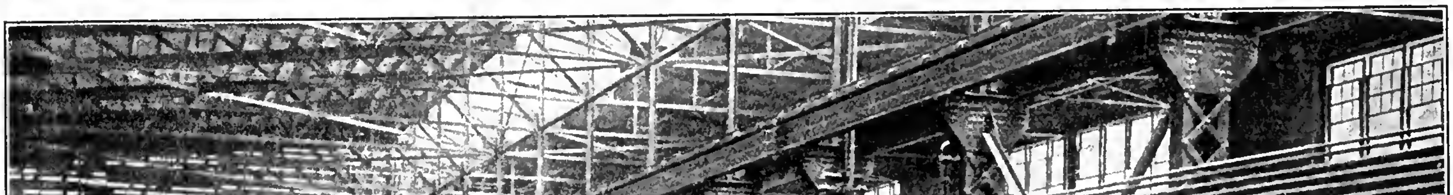
Any surplus supply of grit is carried back in this plant to the building marked "E," where it is ground into fine flour dust and finally deposited in 100-lb. bags. This dust is now used very largely in the coating surface of asphalt pavements.

A useful part of the equipment of this company is a 15-ton, 8-wheeler, locomotive crane, link-belt type, with 50 ft. boom. It frequently happens that one or other size of crushed stone is in excess and the company finds it necessary to take these out of the storage building, D, and place in piles beside the railway siding, where 10,000 tons can be piled. For unloading and loading purposes this crane is used.

5 yd. Bucyrus Steam Shovel.

Another interesting feature which indicates the modern equipment of this company, is the use of a 5-in. well drill, which is used for drilling the 18 ft. face of the quarry. This type of drill, we understand,

Miramichi sandstone. Quarry of the Miramichi Quarry Co., Quarryville, N. B.



Stanstead granite. Interior of the Stanstead Granite Co's mill, Beebe Plain, Que.

is replacing other drills at the present time on account of its much greater capacity both for quantity and depth.

The Kirkfield quarries of Crushed Stone, Limited, are, at present showing, almost unlimited in extent. The initial working will be about 600 feet in length with, as already intimated, an 18 ft. face. No stone is quarried for any purpose other than crushed stone. Mr. W. H. Essery is in charge of the operations at the quarry, while Mr. G. W. Essery, his son, attends to all the general business and sales at the Toronto office, 47 Yonge St. Arcade. To the energy and fine executive ability of these men the success of Crushed Stone, Limited, is entirely due. This success is indicated by the fact that the business has grown in a short time from 20,000 tons per year to over 100,000 tons per year.

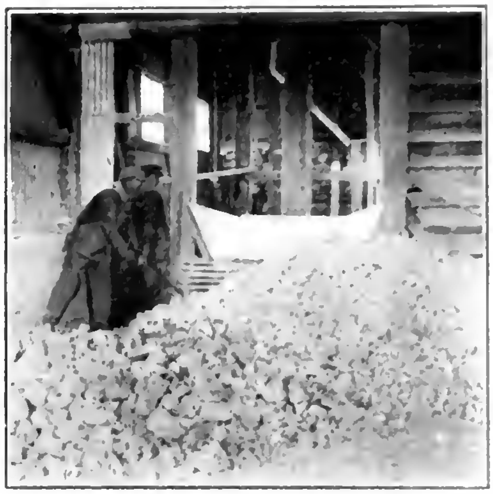
Alabaster Hydrated Lime

Alabaster Hydrated Lime is lime of great purity and strength, which has been slaked or hydrated at the kilns by adding to the fresh burned lime just the right amount of water. It is carefully and scientifically handled, packed in 40 lb. bags, in fine, dry powder form, water slaked and ready for use.

The limestone, which is a Dolomite lime, is blasted out of the solid ledge in the quarry and broken up into the proper size for burning. It is then taken to the kilns and burnt. This process is a continuous one—rock put in at the top and burnt lump lime taken out below. The burning is done to drive off the carbon dioxide and any moisture in the rock. A limestone weighing 100 lbs., put in at the top, weighs approximately 56 lbs. when it is taken out at the bottom.

View of Lime Kilns and Hydrating Plant. Two more kilns under construction.

The freshly burned lime, after being drawn out of the kiln, is allowed to cool and then shovelled into the hopper of a large rotary crusher, which crushes the lime down to ¼ in., or smaller size. After passing through the crusher the pulverized lime is elevated to a storage bin, fed from there into a weighing hopper, and from the hopper into the hydrator, a large revolving pan with stationary plows which turn the lime over as the pan revolves. The proper amount of water is added and as slaking takes place, heat is generated and a chemical action occurs, which, when just the right proportion of water is used, produces commercial hydrated lime. The hydrated lime, having taken all the water it will absorb, will consequently absorb no more moisture from the air, as the free lime has all been slaked, whereas air slaked lime has slowly absorbed moisture and also carbon dioxide from the air and has thereby lost part of its cementitious qualities. After passing the hydrator, the lime is ground



Supply of freshly burned lime.—Alabastine Co., Paris, Ont.

to a very fine powder and automatically bagged in 40-lb. paper sacks.

Besides its major importance as a finish plaster, hydrated lime has several other minor uses—for waterproofing concrete, for agricultural purposes, for paper making, glass making, alkalies, fertilizers, lubricants.

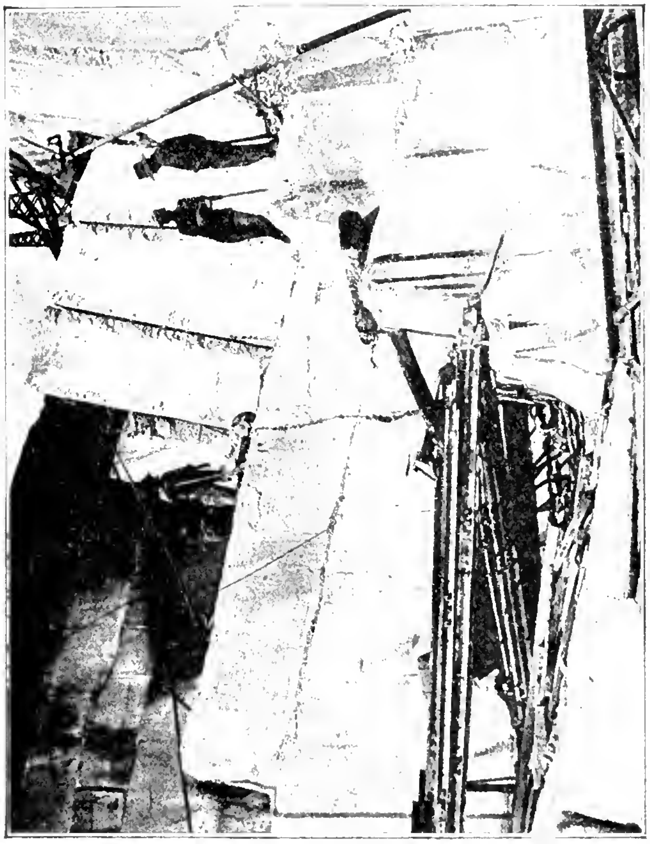
The head office of The Alabastine Co. is in Paris, Ont. The rock deposits and hydrating plant are located at Elora. The same company operate a gypsum mine and mill at Caledonia, Ont.

St. Laurent Quarry Ltd.

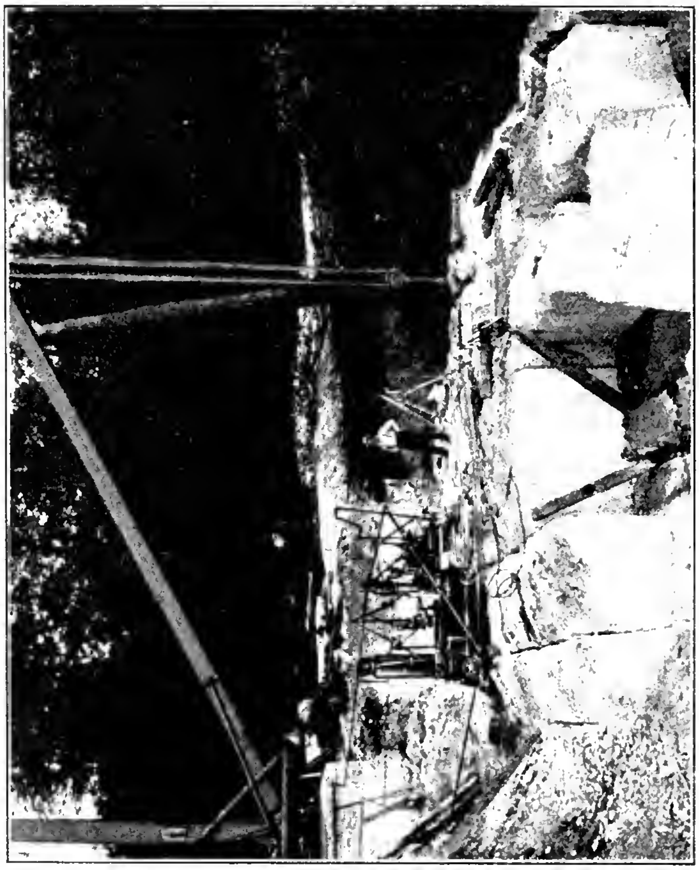
The St. Laurent Quarry Ltd., Cap St. Martin, Que., operate a modern crushing plant at that point. The nature of production is crushed stone of hard limestone in all sizes from 3 in. to ¼ in. screened, also limestone dust. This latter, by Government analysis, is found to contain 87½ per cent. of pure lime, and is thus a valuable aliment used largely for fertilizing.

The company's crushed stone has been in great demand by the surrounding municipalities for the construction of macadam and concrete roads, and especially for the Montreal and Quebec Highway. The crushing plant consists of different sizes of crushers, with a total daily capacity of 800 tons. It is situated at Cap St. Martin, Que., Laval County, close to St. Martin Junction, which is a junction point between Ottawa and Quebec, on the C. P. R., a short distance from the city of Montreal. The head office is at the plant.

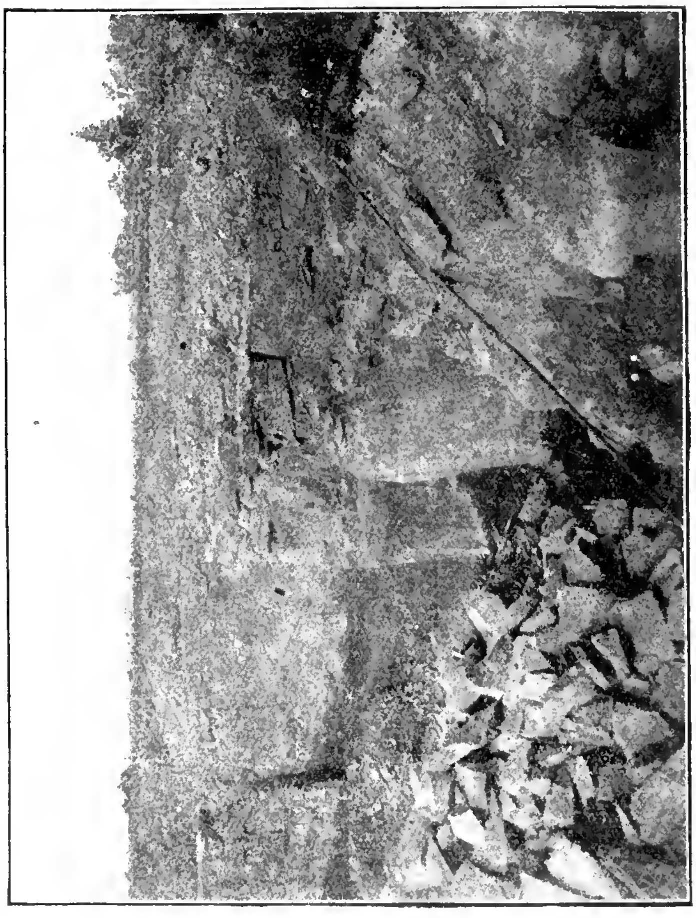
The office staff of the company consists of Mr. Francois Dufresne, St. Laurent, Que., well known as general contractor, having to his credit the erection of many large buildings, as, for example, the Windsor Station Annex, C.P.R., Montreal; the Good Shepherd Building, Laval des Rapides, Que.; the manager, Mr. Charles Le Pailleur, St. Laurent, Que., who has been engaged in the business for the last ten years; the secretary, Mr. J. A. Poulin, Cap St. Martin, Que.



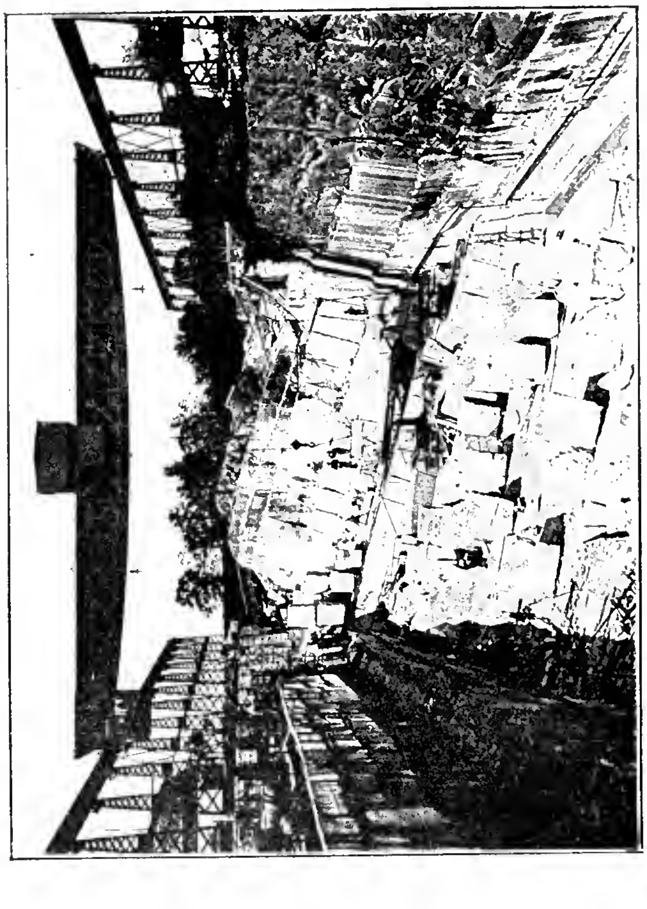
Work of the Channelling Machine, Missisquoi Marble Company, Phillipsburg, Que.



South Stukely marble—Cutting marble blocks from surface at the quarry of the Dominion Marble Company, South Stukely, Que.



View of the Wallace Sandstone Quarries Company, Wallace, N. S.



Quarry and Electric Crane of the Missisquoi Marble Company, Phillipsburg, Que

Credit Valley an Architects' Favorite

Lends Itself to Artistic Design—Shown at its Best in Ontario's Schools, Colleges, Churches and Handsomest Dwellings

A CONSIDERABLE part of the grey sandstone used in Toronto in recent years in the construction of public buildings, has been obtained from what is known as the Credit Valley area in and around Glen Williams, which is only a few miles from Georgetown, and about 30 miles from the city of Toronto.

One of the principal owners and most extensive operators in this section is the firm of F. Rogers & Co., 1193 Queen Street West, Toronto. The company own outright two of the biggest quarry properties there, and another very extensive one is worked in conjunction with Mr. Hugh Logan, of Glen Williams. Here can be found some of the finest grey Medina sandstone which makes one of the best building stones at present produced from the sedimentary rocks of Ontario. The coloring of the stone is practically perfect. Beneath the capping of debris in the quarry lie about five feet of thin, shaley limestone, from which only a little rubble is procured. Then follows 14 feet of sandstone, of which the upper 7 feet is excellent grey freestone of varying thicknesses, the lower seven feet being one solid bed of beautiful blue-grey color. In some places a single bed occupies the whole of the 7 feet.

A practically unlimited supply of the largest blocks is to be found all over the quarries. Railway switches are laid right into the quarries and all modern equipment for the handling of the largest orders in the shortest possible time. Heretofore the company have not sawn the stone themselves, but modern stone-sawing equipment in the nature of several gang saws, is now being placed in the Logan quarries, which will enable them to deliver orders sawn to specifications. From time to time further equipment along the line of planers and lathes will be installed, so that every class of finished stone work can be supplied in Canada from a Canadian quarry.

Some of the largest and most representative public buildings and residences in Toronto have, within the last few years, been built with the stone supplied by F. Rogers and Company from these quarries. Among these we might mention, Toronto Technical School, Knox College, Bishop Strachan School, Victoria Library, Burwash Hall, Yonge Street Methodist Church, Rosedale Congregational Church, the Pellatt residence, the Hart House, Queen's Park; Hon. A. E. Kemp's residence, Mr. Gurney's residence, Spadina Road; Metropolitan Methodist parsonage.

In addition to these quarries, the Oliver, Rogers Crushed Stone Company, Limited, of Owen Sound, is, in conjunction with Mr. Oliver, of that town, owned and operated by the same company. This is a most modern crushed stone quarry with a daily capacity of 500 tons and a full equipment comprising 2 crushers, elevator, steam shovels, and shipping facilities from three sidings into the yards.

Preparedness

Is your machinery in good order? And have you sufficient labor in sight for the coming season? Preparedness in the plant is a big factor in increasing your business and producing profits. The company that is willing to handle all classes of work the quarry is capable of, is, other things being equal, the one that will make good profits. With building increasing, better opportunities for cut stone men are constantly presenting themselves. Watch the opportunities and see that substitutes are not allowed to slip in ahead of you—no matter whether the contracts are great or small. Watch for every class of work. Emphasize the lasting qualities of stone, its solidarity and beauty. These qualities, with a preparedness for bigger volume of business, will be the prime factors leading to success in the Canadian stone trade.

In the case of certain stones, particularly sandstones, the process of seasoning adds greatly to the hardness. In such cases it is the practice to carve the stone before the quarry water has evaporated, and then to hold the product out of the wall until the seasoning is complete.

Knox College, Toronto—One of Canada's most beautiful buildings Credit Valley Stone.

Longford Quarry Co., Longford Mills

One of the best known Ontario quarries is that of the Longford Quarry Co., Ltd., situated at Longford Mills, a station on the Northern Division of the Grand Trunk Railway, 93 miles north of Toronto. The quarries comprise the easterly portions of Lots Gore "A," 21, 22, 23, 24, 26, and 27, Front Range, Township of Rama, Ontario County. The stone is a hard, fine-grained limestone, lying in beds varying from 4 in. to 16 in. in thickness. In color it is a very light grey, which tends to whiten with age. It is almost impervious to water and as a consequence does not soil or become discolored after being built in. The following are copies of tests as made by the Department of Public Works of Canada:—

Sample No. 1—Area exposed to crushing, 2.9 in. x 3.0 in. = 8.7 sq. in.; height of sample, 3 in.; ultimate crushing load, 181,000 pounds; crushing strength, per sq. inch, 20,805 pounds.

Sample No. 2—Area exposed to crushing, 3.4 in. x 3.4 in. = 11.56 sq. inches; height of sample, 3 in.; ultimate crushing load, above 200,000 pounds. (Note.—The strength of No. 2 was beyond the capacity of the machine, 200,000 lbs.)

Immense quantities of this stone were used by the Canada Iron Corporation, Limited, prior to their close-down in August, 1913, and we understand they found it most satisfactory for this purpose after a number of tests. As a broken stone for roads it is first-class material, as the roads adjacent to the quarries, where it has been used for a number of years, bear witness. Under traffic, it breaks up into fine particles which cement together, forming a good surface. Mixed with a proper proportion of broken granite, it makes an almost ideal road material. As a foundation stone it has gone into many of the large buildings of the country, among others the Temple Building, the Union Station, the Eaton Building, and several others in Toronto. The Toronto, Hamilton & Buffalo Railway tunnel at Hamilton, and the railway subways at King and Queen Streets West, Toronto, are built of it. It is, however, as a dressed stone for the better class of buildings of all kinds that its readiest market is found. In public buildings of all kinds it has been used to a great extent, notably in the post offices at Tilbury, Seaforth, Hanover, Aurora, Midland, Orillia, Port Perry, Lindsay, Bracebridge, and North Bay, in the drill halls at Peterboro, Oshawa, Lindsay, Barrie, and Orillia; in Roman Catholic churches at North Bay, Midland, Chelmsford, Orillia, and Peterboro (which are entirely of stone), and as trimming in a great number of other churches throughout the country. Among residences into which it has been built are those of Sir William Mackenzie, Avenue Road, Toronto; Frederick Mercer, Moore Park, Toronto, and J. B. Tudhope, Orillia.

The quarry is at present using a steam driven air compressor to run the rock drills and stone cutters' tools, and horses for thirteen derricks. The company hope, however, to get electric power in the near future.

Church of Angel's Guardian, Orillia—Constructed of Limestone from Longford Quarries

York Sand & Gravel Co.'s Operations

An Industry of Big Proportions that has Grown Rapidly—Company's Products in Increasing Demand

CANADA is a country rich in undeveloped possibilities, no only as regards her great northern and western stretches, but even in older portions. Right at the very borders of one of our greatest cities for years there have existed undreamed-of possibilities awaiting the discerning eye and the enterprising spirit of the pioneer to discover and develop. Such a possibility existed for years in the form of rich deposits of sand and gravel of the highest quality for construction work at the very door of a great market for such products, the city of Toronto, until the keen, discerning eye of a few of Toronto's shrewdest business men recognized the possibilities that lay there undeveloped. The result of this discovery was the formation of the York Sand & Gravel Co., Ltd., for the purpose of placing on the market this material, which became so popular that this company has grown to be not only the largest producers and dealers in sand and gravel in Toronto, but also one of the largest concerns of its kind in the Dominion.

The situation is ideal, comprising some fifty acres of land, rich in sand and gravel, in the township of Scarboro, in close proximity to Toronto, a portion of the property actually lying within the city limits. Being within the Toronto terminals of the Grand Trunk Railway, quick delivery at lowest possible cost can be given to any railway siding on the G. T. R. or connecting systems, in Toronto or its vicinity; also, if required, by motor truck or wagon delivery. The plant, which is of an elaborate and extensive character, has a present productive capacity of two thousand cubic yards per day, and an additional screening and washing plant is being installed, which will be the first of its kind in operation in Canada for commercial purposes; this will still further increase the productive capacity of the plant. To supply material of a special grade required in connection with the million dollar Filtration Plant constructed by the city of Toronto, special equipment has been installed on the company's property, which is something entirely new and an eye-opener to users of sand.

No order is too small to receive the most careful and courteous consideration, and no order is too large to meet with the prompt and efficient service which is characteristic of this company. It is only necessary to mention a few of the contracts of the company to prove the character of their products and their ability to give prompt delivery in large quantities. For example, "York sand" and "York gravel" were the materials used in the construction of such examples of concrete construction as the great Bloor Street Viaduct, the new Union Station, the two latest Toronto skyscrapers, namely, the Royal Bank and Dominion Bank buildings, and it is being used now in the big Robert Simpson Factory, the Eaton Factory, and the new Imperial Oil Co. building, all at present under construction. Large quantities of material have also been supplied to the Toronto-Hamilton Highway Commission, and during the present year this company is the holder of the city of Toronto's contract for supplying the corporation's requirements of sand and gravel for all purposes.

To any person interested in the development of our

General view, showing one phase of York Sand & Gravel Company's operations.

country's industry, a visit to the plant of the York Sand and Gravel Co., Ltd., will prove of interest; especially to those of our readers who are interested in the great development that has and is taking place in concrete construction, a visit will prove of educational value, and to many, doubtless, a source of profit, as well, when they come to figure on contracts. Interested visitors are always welcome, and the president of the company, Mr. T. J. Smyth, is always glad to show them over the plant and explain the same to them.

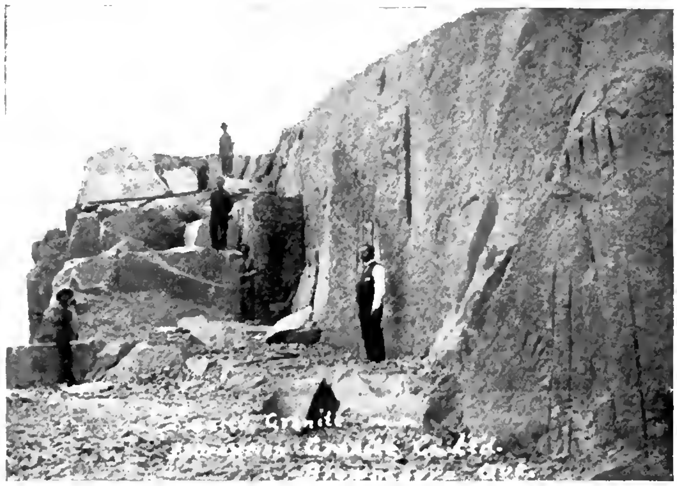
Street & O'Brien, Gananoque, Ont.

The firm of Street & O'Brien commenced work in their quarries in Gananoque in 1906. The stone is a very good quality of granite, colors red and dark blue, and an excellent stone for building and monumental work. This firm have also supplied the cities of Toronto, Montreal, and Hamilton with granite paving blocks. The stone lies in sheets from two feet and up to ten feet deep, and is a good solid stone, without seams or cracks.

Laurentian Granite Quarries

The quarries of the Laurentian Granite Company, Limited, 224 St. James Street, Montreal, are situated in the Township of Chatham, in the County of Argenteuil, P.Q., and are connected by a spur about 5 miles in length, with the Canadian Pacific Railway at Staynerville, P.Q. They cover an area of about 150 acres. The product is a medium to coarse grained granite of a pinkish to light chocolate color, crushing strength, 37,590 lbs. per sq. inch.

The equipment consists of hoisting engines, air compressors, pneumatic and steam drills, large crushing plant with a capacity of 500 tons per day, locomotive crane, completely equipped stone cutting shed,

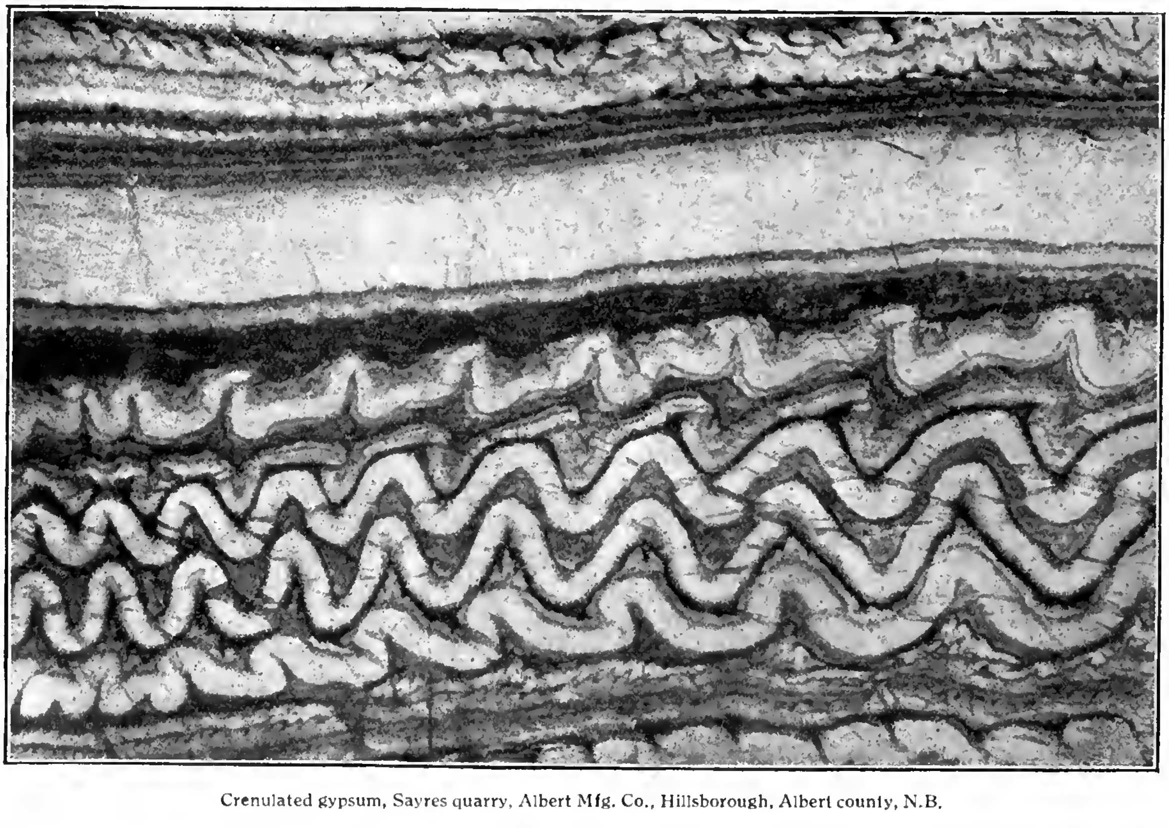


Solid granite quarry of Laurentian Company.

150 ft. x 60 ft. This company can execute any work in the granite line: building stone, curbing, paving blocks, crushed granite, etc., etc.

Laurentian granite has been used in the following structures: Montreal Jail at Bordeaux, Court House at Sherbrooke, Bank of Hochelaga at Three Rivers, Post Office at Hochelaga, University of Alberta at Edmonton, and many other important buildings. Work was resumed this year early in April, after a suspension during the winter months.

At the request of the Westmount Council, the Province of Quebec Association of Architects nominated the following four members to sit on the Westmount Commission which will pass on plans of new buildings:—Messrs. John S. Archibald, Robert Findlay, D. H. MacFarlane, and D. Norman McVicar. All four are citizens of Westmount.



Crenulated gypsum, Sayres quarry, Albert Mfg. Co., Hillsborough, Albert county, N.B.

Quarries in Central and Western Canada

Deposits at Tyndall, near Winnipeg, one of our Largest—Sechelt Quarries on the Coast Yielding a Fine Granite

THE granite quarries operated by the Sechelt Granite Quarries, Limited, are located about 65 miles up the coast from Vancouver, on Hardy Island. This quarry was opened up for the purpose of supplying the large granite blocks required in the construction of the Victoria Harbor breakwater, which is now being built by the Sir John Jackson (Canada) Limited, under a contract with the Dominion Government. The specifications for this work called for rectangular granite blocks weighing from eight to twenty tons each, and the quantity required to complete the contract will be from sixty to seventy thousand cubic yards.

The work of installing the plant was commenced in November, 1913, and the first stone was delivered in March, 1914. As the entire quantity was required to be delivered in less than three years, it was necessary to increase the original plant from time to time as the work progressed, so that the output has been brought up to 100,000 to 120,000 cubic feet per month.

The plant consists of six large derricks and steam hoists, each capable of lifting thirty tons, with masts ninety and one hundred feet high, and booms with a radius of about one hundred feet. Pneumatic drills are used throughout, the air being delivered by four compressors, one of which is belt driven, the power being furnished by a 50 h.p. internal combustion engine; the other three are steam driven from a central steam plant.

The quarry was opened up towards the top of a bluff about 150 feet high, and the blocks lowered to the water's edge by means of a gravity railway about 900 feet long. As the loaded car descends the empty car goes up, both being connected by a cable which passes over a snubbing device at the top, which controls the speed of the cars. Arriving at the water's edge, the blocks are lifted onto scows and thence towed to the harbor works at Victoria.

The magnitude of the work has required the installation of the largest and most up-to-date plant of its kind on the Pacific Coast, with a capacity exceeding any other quarry in the West. Frequently blocks of granite containing upwards of 50,000 cu. ft. are blown clear of the bluff by the use of powder, so that easy quarrying can be done.

Over 100 men are employed. Two tugs and five scows are constantly engaged in the work of transporting the output to Victoria.

The quarry is situated in a good harbor on Blind Bay, with deep water and the best of shipping facilities.

The Quarry Company are in the market for the supply of granite to any location for buildings, and the granite is a very good quality. Blocks of granite any size can be secured.

It is remarkable with what accuracy the stone cleaves. Plugs and "feathers" are used for reducing large blocks to the required sizes, and stones any length and 15 feet wide can be split perfectly true in this manner.

Tyndall Quarry Co.

One of the largest quarries in Canada is owned by the Tyndall Quarry Co., Ltd. The quarry is situated at Tyndall, Man., thirty miles east of Winnipeg, and consists of a very fine limestone which is economical

Sechelt Granite Quarries, Hardy Island, B.C.—Splendid Quarrying and Shipping Location.

to manufacture and rich in appearance. The quarry at the present time is equipped to supply cut stone, rubble and lime.

The plant consists of Sullivan and Ingersoll Rand channelers of the latest and heaviest make, to withstand the heavy work which they are subjected to; also a derrick of twenty tons capacity. Owing to the quarry being situated one and one-half miles from the C.P.R. main line, a 22-ton locomotive is utilized to switch the cars in and out of the quarry. The company are interested in four of the best stone cutting mills in Winnipeg, equipped with the most modern machinery that money can purchase.

The stone is being used in all the principal cities and towns throughout the Middle West as far as Calgary and Edmonton and east through Ontario. In Winnipeg, it is used in the new law courts, the Parliament Buildings, the agricultural buildings, and numerous warehouses and residences.

The Wallace Quarries

Sandstone for building purposes is found in many sections of the Maritime Provinces, the most important quarries being in Northumberland and Westmoreland counties, New Brunswick, and in Cumberland county, Nova Scotia. The famous Wallace Quarries are situated in the latter county and have been operated over one hundred years, being one of the largest and best equipped in Canada. Stone has been supplied from these quarries for many of the largest buildings in the Maritime Provinces, including the Parliament Buildings in Halifax, commenced in 1811 and completed in 1815.

During the last half of the last century stone from these provinces was extensively used in Boston, New York, Philadelphia, Baltimore, and other United States cities, but owing to an excessive duty being imposed by the United States Government, these quarries were compelled to abandon those markets and seek a market in Canadian cities, where they meet strong competition from United States stone which is admitted into Canada under a considerably lower tariff than the United States imposes on Canadian stone.

Among the notable buildings erected with Wallace stone in Canada are the Victoria Museum and Custom House, Ottawa, also the Custom House in Montreal.

Last season 42,500 tons of rough stone were supplied the Roger Miller Company, Carleton Point, Prince Edward Island, for car ferry terminals. Owing to war conditions the demand for stone is limited, but when peace is declared the Wallace Sandstone Quarries Co. state they are looking for a brisk trade in building stone.

The Wallace Sandstone Quarries operate also a large plant at Lyall, Manitoba. This plant is one of the largest in the Dominion, and coming to be one of the best known. The stone used in the new station recently built by the C.P.R. and the C.N.R., in North Toronto, on Yonge Street, was supplied by the Wallace Sandstone Quarries Company from their Lyall deposits. This stone is sometimes known as Tyndall stone on account of the close proximity of the two towns, Lyall and Tyndall, which are only about a mile apart. The three illustrations on this page will give some conception of the operations of this quarry.


Wallace Sandstone Quarries Co., Ltd., operations, Lyall, Man.

Two additions, 20 ft. by 100 ft. and 40 ft. by 80 ft., are being made to the plant of the Dominion Sheet Metal Company, manufacturers of "Premier" galvanized sheets, Hamilton, Ont. This company is sparing no efforts to give Canadian buyers of galvanized sheets a steady supply at this time, when import shipments are negligible. This has only been accomplished by high pressure work on the part of a thoroughly experienced staff and by having largely provided in advance against present extraordinary conditions.


Wallace Sandstone Quarries Co. operations, Lyall, Man.


Interior of Lyall Mill, Wallace Sandstone Quarries Co.

Masson Quarry, Montreal

The Masson quarry, located on a ridge of rock to the north of the C.P.R. Angus shops, Montreal, is operated by O. Martineau & Fils, trading as the Morrison Quarry Company, the selling agents of which are T. A. Morrison & Co., 204 St. James Street, Montreal. The great feature of the plant for producing crushed stone is the employment of electrical driven derricks, further described in another portion of this article.

The rock is of igneous formation, and is locally known as "Banc Rouge" Trap Rock. A recent analysis made by the Milton Hersey Co., Ltd., gives the following mineral analysis:—

T. A. Morrison & Company's crushing plant. Cut of quarry shown on page 569

Nephelite (Silicate of alumina, soda, and potash)	52.0%
Orthoclase (Silicate of alumina, and potash) ...	17.8%
Acmite (Silicate of iron and soda)	12.8%
Kaolin (Hydrous silicate of alumina)	17.4%
Specific Gravity	2.50%
Weight per cubic foot	156 pounds

This rock is particularly good for road work; it is very hard and tough, and has high wearing qualities.

The plant is very complete and produces crushed stone of the various sizes required for road building and concrete work. It is operated as two complete units. In the cut of the general view of the plant, on the right side is shown one unit consisting of four Champion No. 5 crushers, which reduce the stone to 2½ in. This stone is elevated from the quarry and passed through long screens which select the various sizes into separate chambers in the large hopper. The rejections come back and are reduced to ¾ in. by two 24-in. Simond disc crushers.

The plant is arranged to avoid hand labor. Two five-ton Pollard electric horizontal beam derricks hoist the stone direct from the quarry and dump it on the platform, which feeds through a hopper into the No. 5 crushers.

The second unit comprises a No. 5 Austin Gyratory Crusher, fed by two Anderson electric beam derricks. The stone passes through the Austin crusher, is elevated, and all the stone 2 in. and under is screened and deposited in the various chambers. The rejections are then passed through a 48-in. Simond disc crusher, screened as above, and the rejections again pass through a 24 in. disc crusher, reducing the stone to ¾ in. and under.

The most interesting features of the plant are the beam derricks, two supplied by the Geo. Anderson Company of Canada, Limited, Montreal, and two by the Pollard Manufacturing Company, Niagara Falls, Ont. They are the first of the kind installed in Canada, and greatly facilitate the work of transporting the stone from the quarry to the plant, each having a radius of 45 feet. The derricks have three distinct motions—hoisting, travelling along the beam, and swinging. Each derrick is operated by individual electric motors.

In drilling the rock, well drills are employed; these make a hole 3½ to 4 in. in diameter and 40 feet deep, that is, nearly to the bottom of the top formation of the rock. The holes are sprung, and then heavily charged, breaking up the rock to convenient sizes for sledging.

The rock is only suitable for crushing purposes, being of such a nature that it does not lend itself to hand cutting for building.

Famous "Queenston Blue"

One of the largest quarry operations in Canada is to be found in the Niagara district, where the Queenston Quarry Co., Ltd., produce the well-known "Queenston Blue" Limestone.

The stone is dolomitic in nature, containing granular crystals and small fossil organisms. The color is a beautiful bluish grey, which changes very little through the lapse of time and withstands atmospheric conditions to a remarkable degree, keeping a sharp clean face for a considerable period.

The extent of operations may be gauged from the fact that over twelve acres of this stone have been quarried to depths running from twelve to thirty feet.

General view of Queenston Company's quarry at St. David's, June 1, 1916.

The present plant consists of seven derricks of from ten to twenty ton capacity, compressed air plant, and large stone sawing mill, giving a quarrying capacity of about 200,000 cubic feet of stone per season; also a stone crushing plant of eight cars per day capacity.

This stone is used for all classes of construction and building operations, from residential foundations to the modern skyscraper, canal construction, bridges, tunnels, railway stations, churches, public buildings, colleges, schools, banks, hotel, manufacturing and business buildings, residences, and monumental work. Among the more notable examples of this stone are the present Welland Canal locks; bridge piers on the spans across Niagara River; Brock's Monument at Queenston Heights; power plants of the Niagara Falls Power Co., and the Canadian Niagara Power Co., at Niagara Falls; new Mountain Hospital, Hamilton; new Civic Library, Montreal;St. Henri Church, Montreal; gateway to Rideau Hall, Ottawa; St. Patrick's Church, Toronto; several schools and public buildings throughout Ontario. Also a large quantity of this stone is shipped annually to the United States.

Plug and feather drilling, St. Davids, June 1, 1916.

Additional Information

In a short article which appeared on page 532 of the May 31 issue of The Contract Record, describing the new sub-station of the Mount Royal Tunnel Company, we inadvertently omitted the name of the architect, Mr. C. Gordon Mitchell.

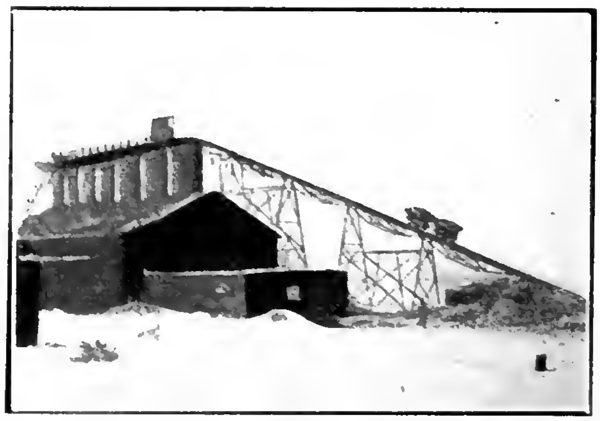
In our article describing the extension of the Montreal Harbour Commissioners' elevator, on page 560 of the June 7 issue of the Contract Record, we stated that the steel was supplied by the Dominion Bridge Company. We have since been advised that the reinforcing steel bars, of which there was a considerable tonnage used in the construction of the elevator, were supplied by the Burlington Steel Company, Limited, of Hamilton, Ont.

The Faultless Hose Reel

The Montgomery Faultless Hose Reel Company, 47 Gore Vale Avenue, Toronto, have made a number of installations this spring of their hose reels in some of the largest public buildings in the country. One of the strong and exclusive features of the Faultless Hose Reel is that it is instantaneously automatic and fool proof. It can either be attached to the wall or built in, in a cabinet form. The reel is so built that the water can be turned on without unwinding the hose as the staves supporting the hose collapse, allowing for the expansion of the hose. This device has been endorsed by the Ontario Government and is being placed in all their principal buildings, including the Toronto Parliament Building. It has also been specified for the million-dollar wing known as the Ross Memorial Wing of the Royal Victoria Hospital at Montreal.

Standard White Lime Hydrating Plant

The hydrating plant of the Standard White Lime Co., Limited, at Guelph, is shown in the accompanying illustration. The same company have works also at Beachville and St. Marys. In these plants are manufactured high calcium, magnesium, and hydrated lime. The Guelph lime runs high in magnesium, which makes it very desirable for strong hydrate. The Beachville and St. Marys plants produce high calcium lime, which is in great demand for chemical preparations and also in steel plants, ammonia and sugar beet factories, tanneries and carbide factories.



"Standard" Hydrating Plant, Guelph, Ont.

At a recent meeting, the reeves of North Essex, Ont., decided to put a good roads system in operation, according to a plan outlined by Mr. George Hogarth, engineer of the Department of Public Works, Toronto.

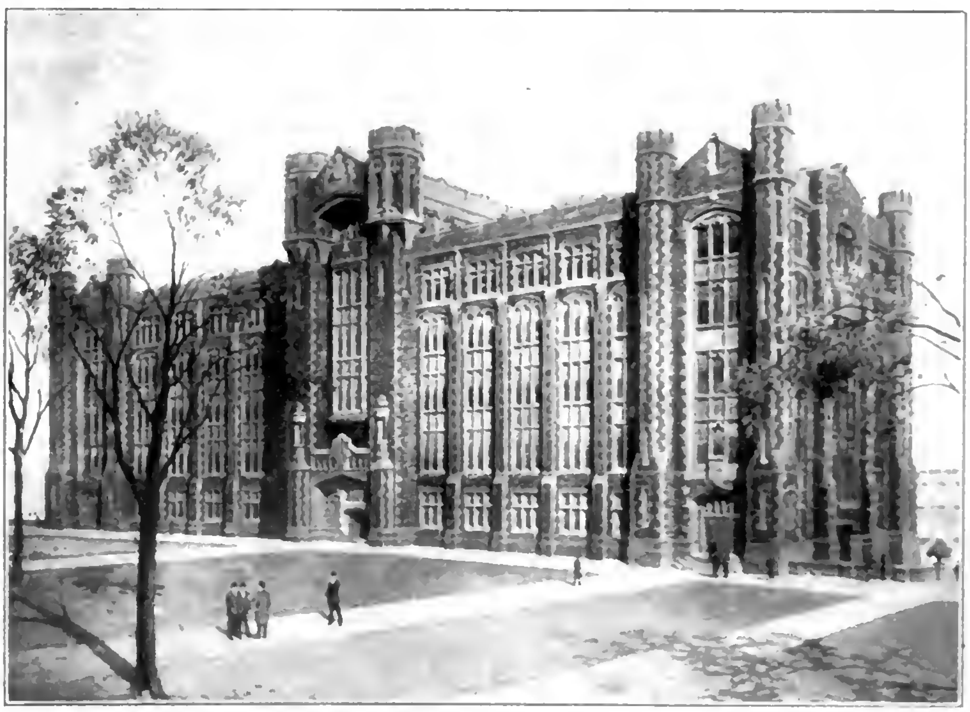
Schaw Quarry Guelph, Ont.

One of the successful limestone crushed stone or rubble stone quarries supplying the city of Toronto and vicinity is that owned and operated by John Maloney. This quarry, known as the Schaw Quarry, is situated west of Schaw, near Guelph, Ont., in the Gore of Puslinch, and about 45 miles from Toronto, on the Canadian Pacific Railway. In this vicinity are wide exposures of rock and many acres of quarry land on which is a very light stripping. The quarry is about 1,000 feet by 300 feet and shows a more regular bedding than is common in the Guelph formation. The upper 14 feet presents stone varying in thickness from two to ten inches. Distinct bedding planes are shown at frequent intervals. Below this level the quarry is opened at a few points to a depth of 11 feet, exposing beds of a rather finer character in layers up to 10 inches thick. An up-to-date equipment at the quarry, including a No. 5 and a No. 3 Gates rotary crusher, gives a capacity of 300 tons per day. Mr. Maloney's head office is at Queen and Dufferin Streets, Toronto. He also maintains a large brick yard at the Humber

D. J. Gordon Granite Company

The D. J. Gordon Granite Co., Gananoque, Ont., have been operating this year, since February 1. Their chief line of business has been manufacturing granite paving blocks, mostly for the city of Toronto. The granite is of two classes—one fine in grain, the other coarse grain. The fine grain is only suitable for paving blocks, curbing, and rough building work. Paving blocks from this stone can be made as clean and trimmed so as to pave as close as artificial brick or wooden block pavement. The coarse grain is red in color, similar to Scotch granite used for monumental purposes. This granite would appear to be strictly adapted for building purposes, this company claim, as there is no granite equal to it now used for such purpose in Canada.

This quarry is the nearest granite quarry to the city of Toronto. They have a large deposit of red granite, more than could be quarried in several generations, and are equipped and make delivery in any form except in crushed form

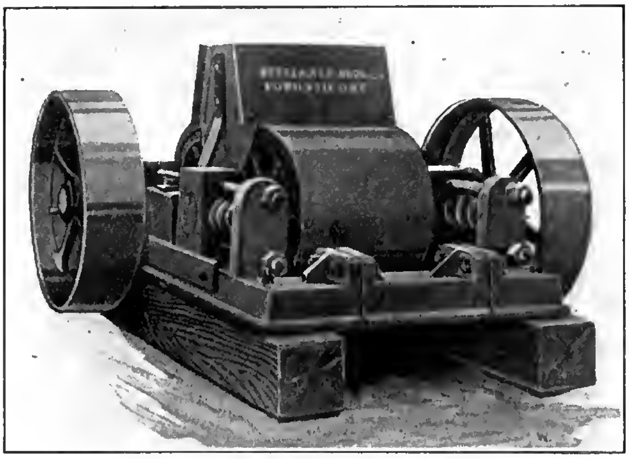


Ottawa Examining Warehouse - Stone supplied by Wallace Sandstone Quarries Company

Improved Crushing Rolls

Messrs. Wettlaufer Bros., 178 Spadina Avenue, Toronto, have placed on the market a line of new and improved crushing or pulverizing rolls, with capacity ranging from 36 to 4,000 tons for ten hours. These rolls are adjustable for crushing rock or stone to any size down to dust, and have shown themselves to be very efficient in stone quarries, especially where increased capacity was necessary, and also where car loads of certain sized rock were wanted for immediate shipment. It often happens that a quarry or stone company has a capacity of certain sized rock per day and are continually in trouble through not being able to supply the sizes called for. With these new rolls you adjust instantly to any size and orders may be executed immediately.

The manufacturers claim that these rolls have re-



Pulverizing Rolls

placed a good many crushers and are giving great satisfaction on account of the wonderful range of their work. They will reduce stone to powder or any fineness desired. Stone dust is now used in many cases instead of sand in making concrete. This is said to improve the quality of the concrete as stone possesses special binding qualities.

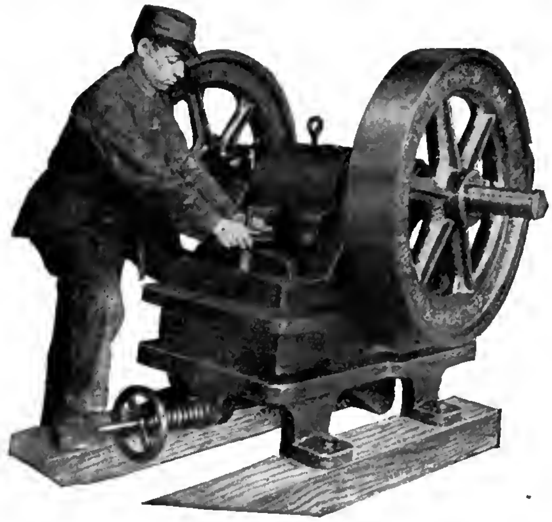
Contractors can use pulverizing rolls for tile, brick and block and it is claimed that at least 30 per cent. is saved in the quantity of cement required.

These rolls are said to be especially effective in gravel plants for crushing boulders and large gravel. In the case of ordinary crushers the gravel will slip through between the jaws without being crushed.

An Efficient Crusher

The illustration shows a No. 3 Wettlaufer improved crusher, manufactured by Messrs. Wettlaufer Bros., 178 Spadina Avenue, Toronto, which has a capacity of 20 to 70 tons in ten hours. The weight is about 6,000 pounds, and the jaw opening 8 in. x 14 in. This crusher is equipped with ring oilers and slip head pitman for wear in the eccentric bearing. All crushers are equipped with bronze babbitt bearing. All plates are made of manganese steel.

Unless otherwise specified the crusher is equipped with corrugated jaw plates. These plates will take hold of larger rock than with the smooth jaws. Smooth plates, however, are recommended where it is necessary to crush rock to a sand fineness. The stationary jaw plate is held in place by key wedges, which form the double purpose of holding in the jaw and also protecting the bed from any possible wear. Where unusually hard material is being crushed the key plates are also made of manganese steel. This crusher has only three bearings, which require less power to operate than the ordinary crusher, with nine and twelve bearings, and the cost of renewing of these bearings in comparison with nine or more bearings is at least 60 per cent. less.



No. 3 Crusher

One of the most valuable features of this crusher is its instant adjustment. The distance between the jaws is regulated by turning a hand-wheel so that a product can be made in any desired size. The single eccentric produces a peculiar crushing and grinding motion in the movable jaw. This is a reciprocating horizontal and vertical motion, which crushes and grinds in the same revolution. It greatly assists in cutting down the amount of power required.

This machine is particularly popular with block and tile manufacturers who require a machine which will crush rock or gravel rejections fine enough for use in their product.

Adam Hill's quarry of Miramichi sandstone, at Cassilis, near Newcastle, N.B., is illustrated elsewhere in this issue. Last summer they had the contract of the new hospital in Newcastle, which took one thousand tons, besides a few hundred tons to other parties. It is a beautiful stone and there seems to be plenty of it. The quarry is on the bank of the Miramichi river—a good water front and a good location.

The Raymond Concrete Pile Co., Limited, of Montreal, have been awarded the contract for the foundations of the St. Maurice Paper Co.'s new plant at Cap de la Madelaine. There will be between 400 and 500 piles. The George A. Fuller Company, Limited, are general contractors.

George W. Tillson, M. Am. Soc. C. E., Henry G. Shirley, M. Am. Sos. C. E., and Arthur H. Blanchard, M. Am. Soc. C. E., a Commission of Engineers, appointed by the Wilmington Chamber of Commerce, have recently submitted a Report on the Administration, Construction and Maintenance of Highways which are under the jurisdiction of the Levy Court of New Castle County, Delaware.

Personal

Major Thos. C. Irving, of the Canadian Engineers, was among those who received King's birthday honors, being decorated with the D.S.O.

Captain G. H. Blackader, reported wounded in the recent fighting, is a member of the firm of Barott, Blackader and Webster, architects, Montreal.

Mr. W. G. Chace, chief engineer of the Greater Winnipeg water district, has been elected chairman of the Winnipeg branch of the Canadian Society of Civil Engineers.

City Engineer Craig, of Calgary, Alta., just recently made a long trip through Eastern Canada and the States and has now returned to Calgary with renewed health and vigor.

Among the birthday honors was the award of the C.M.G. to Lieut.-Col. Ramsay, the C.P.R. engineer, for organizing the railway construction corps, which has done such excellent work in France.

Thos. M. Fyshe, A.M. Can. Soc. C. E., has been appointed Canadian manager for Gunn, Richards & Company, production engineers, Montreal. Mr. Fyshe was a prominent Calgary contractor.

H. Victor Brayley, C.E., has accepted a position as executive assistant to Mortimer B. Davis, a Montreal manufacturer and capitalist. He was formerly manager for Gunn, Richards & Co., Montreal.

Sapper Nathaniel A. Burwash, 6th Brigade, Canadian Engineers, is reported wounded. He is a graduate of the Department of Mining and Engineering in the University of Toronto, and was born at Cobourg, Ont.

Mr. J. C. Johnstone, town engineer, Port Alberni, B.C., now in France with the Canadian Engineering Corps, has won his commission on the field. In the latest report he expected to return to England for a short time on leave.

On the assurance of Mr. P. Mercier, the chief engineer of Montreal, that he could do the asphalt paving work at $2.12 per yard by day labor, against $2.33 by contract, the Board of Control have rescinded a resolution calling for tenders.

Obituary

Mr. Josiah Mason, a well-known Brampton contractor, died recently at his home in that town. Mr. Mason was one of the oldest builders in the neighborhood and many of the fine residences and public buildings in Peel County, Ont., were erected by him.

Mr. John W. Messacar passed away recently at his home in Hamilton, Ont., at the age of 59 years. Mr. Messacar lived the greater part of his life in Millgrove, and for the last ten years had been a resident of Hamilton, where he was engaged in business as a building contractor.

The death is announced of Mr. Edwin Buscombe, of the firm of E. J. Buscombe, at his home in Hamilton, Ont. Mr. Buscombe was in his sixtieth year. He was born in England, but had resided in Hamilton for about 44 years. He had a large circle of friends and took an active interest in many societies, including the Builders' Exchange, of which he was a member.

Mr. C. R. Scholes, of New Carlisle, Que., well known through his connection with various railroad enterprises, died recently at Bermuda, where he had gone on a visit for his health. Amongst the undertakings with which the late Mr. Scholes was connected, were the building of the Caraquet Railway, the Central Railway of New Brunswick, and the Atlantic and Lake Superior Railway. At various periods he was manager of the Salisbury & Harvey Railway, the Atlantic and Lake Superior Railway, the Quebec, Oriental and Atlantic, and the Quebec and Western Railways.

Mainly Constructional

East and West—From Coast to Coast

The Barnes Construction Co., Limited, has been incorporated with a capital of $5,000; head office, Montreal, P.Q.

The Canada Stove & Foundry Co., Limited, has been incorporated with a capital of $1,500,000; head office, Montreal, P. Q.

Wm. Marsh & Sons have established an iron and brass foundry in Port Hope, Ont., and are now open for all kinds of foundry work and general jobbing.

The building permits issued in the city of Toronto for the month of May represent a total value of $988,985. These figures are well over those for any month since 1914

Some of the brick companies in Toronto are appealing against the new assessment. They do not think it justifiable on account of conditions in the brick business at the present time.

The work on the Quebec bridge is proceeding with great vigor. The total amount of steel in the bridge when completed will be about 65,000 tons, and it is probable that the outlay will not fall far short of $20,000,000.

Members of the Ontario Good Roads Association recently took a motor trip over the southern portion of Hastings County and through the County of Prince Edward, to Picton, where they were entertained to a banquet.

The report of the consulting engineers to the Greater Winnipeg Water District, recently submitted, urges the use of concrete pipe instead of steel pipe, as at first proposed, for the portion of the aqueduct between Deacon and the Red river.

Geo. W. Reed & Co., Limited, Montreal, announce that their roofing supply department, carried on for some years, has been extended, covering a full line of supplies for the roofing and allied trades, as well as many lines required by the general contractor.

A new lighthouse is to be erected by the Dominion Government at Triple Island, Brown Passage, on the Pacific Coast. It will be of reinforced concrete construction and will be about 65 feet high. A fog alarm and dwelling house building will also be constructed.

The city of Sault Ste. Marie, Ont., are considering a new water system. Coldwater Creek appears to be favored as the most suitable source for the water supply, but has not been decided upon as yet. A plebiscite is shortly to be submitted to the people on the question.

Work on the Lake St. Francis storage dam in the province of Quebec, an undertaking involving an expenditure of about $100,000, will be completed by October of this year, according to a statement made by Hon. S. N. Parent, chairman of the Provincial Streams Commission.

Building permits were issued at Welland, Ont., during the months of May this year representing a total expenditure of $69,072, as compared with $25,841 in May, 1915. The total amount of the building permits for the first five months of the year is $99,196, an increase over the corresponding period last year of $18,323.

Attention has been drawn in the British House of Commons to a creosote disease of brickmakers. The creosote used in lubricating the brick molds often gets on the hands and arms, and in at least one case the injury has resulted in the loss of a limb. Prompt washing is said to be all that is necessary to avoid harm.

John Quinlan, the Montreal contractor, has lost an action against Westmount City in connection with their by-law prohibiting the use of tractor engines within the city limits. Quinlan had a license from the Provincial authorities to operate such vehicles and was attempting to have the Westmount by-law annulled.

Up to May 31st, 1916, there were 61 permits issued in the city of Galt, Ont., representing a total of $59,351, as compared with 65 permits representing $51,330 for the same period last year. During the month of May this year there were 34 permits issued, total $40,991, while in May, 1915, there were 28 permits issued, total $13,095.

The Federal Government of the Province of Quebec are calling for tenders for the reconstruction of the railway depot at Levis which was destroyed by fire last year. The plans for the new building, which will be one of the most up-to-date depots in the province, have been drawn up by the firm of Ross & McDonald, architects, of Montreal.

At the sample fair in Lyons, France, Canada was represented by a fine number of exhibits illustrating the wide range of our products. The firms showing included the C.P.R., Dominion Bridge Company, Page-Hersey Iron Tube and Lead Company, Toronto; Eastern Car Company, New Glasgow, N.S.; National Steel Car Company, Hamilton; and the Dominion Rubber System, Montreal.

A scheme is under way for the building of a highway from Brandon, Man., to Carberry, through Sewell Camp. Plans and estimates are to be furnished the various municipalities by Highway Commissioner McGillivray, so that each will know its share of the cost. This road, when completed will eventually form part of the main highway from Winnipeg to the western boundary of the province.

Hon. Finlay Macdiarmid, Minister of Public Works, Ontario, has issued instructions that a survey be made of the proposed Ottawa-Prescott highway, to prepare estimates and plans for construction. It is expected that the survey work, which is to be started without delay, will occupy at least two months. If the construction is not commenced this fall, it is thought probable that preparations will be made during the winter for an early start in the spring.

A shipbuilding syndicate, represented by M. P. Cotton, contractor, of Vancouver, is negotiating with the G.T.P. Ry. in regard to the leasing of the G.T.P. plant at Prince Rupert, B.C., for the purpose of building freighters to be operated by the company. It is proposed to build the ships of steel, and application has been made under the Government's legislation to aid shipbuilding, for assistance in the building of four of these ships, which will be of about 5,000 tons each.

The contracting firm of Smith and MacDonald are bringing an action in the Supreme Court against the town of Watrous, Sask., to recover $10,000 damages. The case is based on the allegation that Smith & MacDonald refused to go on with the contract on the ground that they could not finance it themselves and that the town of Watrous would not give them back any money on the hold back of $4,000 which it had been necessary to put up before getting the contract.

Halifax harbor work in the construction of the new Ocean Terminals, is progressing favorably. The railway is almost completed to grade throughout, and the sectional hollow concrete quay blocks have been laid for about 1,300 feet of wall, and the foundations are ready for about 1,000 feet more. The placing of mass concrete foundations at depths from 45 ft. to 60 ft. below low water, is being proceeded with, and about 300 ft. of wall foundations have already been successfully prepared in this way.

Mr. Andrew A. Kinghorn, C.E., Toronto, has been appointed by the Provincial Government to supervise the work of the Toronto-Hamilton Highway Commission. There has been considerable dissatisfaction in some municipalities regarding the increased expenditure on the highway, which was originally estimated at $600,000, but is now to cost $900,000. The matter was taken up by certain members of the Legislature, and the agitation finally led to the appointment of Mr. Kinghorn, in order that the work might be executed in a more efficient and satisfactory manner.

There has recently been installed and put into operation at the Clayburn Brick Company's works, Clayburn, B.C., a smokeless heat generator manufactured by Thomas & Mainwarning, of Nanaimo, B.C. The generator, which is claimed to be a wonderful fuel saver, was installed under the personal supervision of the inventor, Mr. Walter Thomas, and so successful were the first tests of the appliance that he received three repeat orders. Coal is used in the generator, and Mr. Thomas claims that it shows its superiority over oil not only in cost but also in wide range of adaptability.

The Dominion Steel Corporation reports for the year ended March 31 last, the largest profits in its history, net manufacturing earnings rising to $7,004,316, an increase of $3,433,258, or 97 per cent., over the previous year. After providing for depreciation, interest charges, discount on bonds, etc., the balance available for dividends was $3,995,225, as against $855,256 a year ago, an increase of 370 per cent. When the Corporation preference dividend had been deducted and allowance made for the full year's dividend on the preferred stocks of the subsidiaries, the balance remaining as net surplus for the year was $3,015,225.

The Provincial Roads Commission of Quebec recently held their first session, at which they outlined a programme for the reconstruction of the old North Shore Turnpike Trust roads. It was decided that a Government engineer should immediately make a report to the Commission on the condition of the upper and lower roads connecting the city with the Quebec-Montreal highway at St. Augustin, and it is expected that this work will be pushed forward as soon as possible. Reports also on the road to Kent House, Charlesbourg, and through Lorette, will be given, after which tenders will be called, and it is expected that the work will be given out in separate sections in order to finish it if possible this season.

Mr. Alexander Sharpe, mining engineer, recently addressed a representative meeting of the citizens of North Vancouver, held under the auspices of the inter-municipal industries committee, regarding the iron resources of Canada and the apparent lack of interest shown in them. Mr. Sharpe stated that there were almost inexhaustible deposits of iron ore in Canada, and in British Columbia the known deposits had been estimated at 46,000,000,000 tons. He urged that the time was opportune for the establishment of an iron and steel smelter on the coast. The first units of this plant could be put in operation for approximately $1,500,000, and with a little Government encouragement, there was every opportunity for great development along these lines.

Work on the new Levis dry dock in the Province of Quebec is proceeding rapidly. About 300 feet on the river side, together with the entrance, have been completed and the excavation work goes on over the whole site. The power house is nearly finished and concrete is being poured for the foundation of the pump house. A 500 foot tunnel, connecting the inner dock with the pumps, has also been completed; through this tunnel three 42-in. axial flow pumps will be able to empty the whole dock in less than three hours. To keep out the river water, the latest type of rolling caisson will be used. The dock, which will be one of the largest of its kind in the world, will be able to hold any boat up to 1,150 feet long with a 120 ft. beam. To handle smaller boats, a large steel floating caisson is being built, which can be moved into place and then submerged, thus dividing the dock into two parts of any desired length. The total expenditure on the dock will approximate $3,000,000.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Ingersoll, Ont.
Tenders will be received until June 16th for the construction of 11,500 square yards of reinforced concrete pavement and 6,300 square yards of tarvia pavement, with curbs and gutters. Plans and specifications at office of the Engineer, F. J. Ure, Woodstock, and at the Town Hall.

St. Thomas, Ont.
The City Council propose to lay a macadam pavement on Burrows Avenue and a reinforced concrete pavement on Moore Street. Clerk, W. B. Doherty.

CONTRACTS AWARDED

Donnacona, Que.
The Municipal Council have awarded a contract for the construction of a drainage system to P. C. Costo, Donnacona. Approximate cost, $13,500.

Toronto, Ont.
The Board of Control have awarded contracts for paving to the following: Godson Contracting Company, Manning Chambers, $2,162; Riverdale Concrete Paving Company, 264 Jones Avenue, $1,573; Commissioner of Works R. C. Harris, $5,229.

Usborne Township, Ont.
The Township Council have awarded the contract for construction of the Brock Creek drain to Joseph Lawson, Crediton, Ont. Approximate cost, $7,468.

Virden, Man.
The Rural Municipality of Wallace have awarded the contract for road work to A. R. Boivin, 167 Notre Dame Street E., Winnipeg, at $18,243.

Railroads, Bridges and Wharves

British Columbia Province.
The Pacific Great Eastern Railway, Vancouver, propose to resume the construction of the line between Cinton and Prince George, and will require 4,000,000 feet of bridge timber.

Essex, Ont.
The Town Clerk, R. R. Brett, will receive tenders until June 19th for the construction of a cement bridge, 50 feet long. Engineer, J. S. Laird.

Finch Township, Ont.
The Township Clerk, A. Cameron, Berwick, Ont., will receive tenders until June 17th, for the construction of concrete bridges, estimated to cost $5,000. Engineers, Magwood & Stidwell, Pitt Street, Cornwall.

Toronto, Ont.
The Board of Control will receive tenders until noon, June 20th, for construction of the proposed subway on Ashdale Avenue. Specifications at Room 311, Department of Works, City Hall.

York County, Ont.
The County Council will receive tenders until June 19th for the construction of a reinforced concrete bridge over the Humber River, with three spans of 82, 62 and 62 feet. Engineer, Frank Barber, 57 Adelaide Street T., Toronto.

CONTRACTS AWARDED.

Wallace, Man.
The Municipal Council have awarded the contract for construction of two reinforced concrete bridges and a culvert to George Harris, Virden. Approximate cost, $3,336.

Public Buildings, Churches and Schools

Ely, Que.
Audet & Charbonneau, 37 King Street, Sherbrooke, are preparing plans of a church and presbytery for the Parish of St. Enfant Jesus. Field stone and stucco construction. Approximate cost, $23,000.

Pembroke Ont.
W. C. Keighley, Box 508, Pembroke, has prepared plans of a school, estimated to cost $40,000, and will call for tenders about the end of the month. Fireproof construction.

Peterboro, Ont.
William Blackwell, Water Street, has prepared plans for remodelling the school at Sherbrooke and Rubridge Streets for the School Board. Estimated cost, $15,000. Tenders will be called shortly.

Rimouski, Que.
The Ursuline Sisters have had plans prepared for an addition to the Normal School, estimated to cost $25,000. Architect, P. Levesque, 115 St. John Street, Quebec. Brick, steel and stone conconstruction.

South Norwich Township, Ont.
The Township Council propose to submit a by-law to authorize the erection of a Library, at an approximate cost of $7,000. Clerk, A. McFarlane, Otterville, Ont.

Stanstead, Que.
Plans of a church to be built for the Roman Catholic Congregation are being prepared by Audet & Charbonneau, 37 King Street, Sherbrooke. Brick construction. Estimated cost, $25,000.

St. Damase, Que.
Plans are being prepared by P. Levesque, 115 St. John Street, Quebec, for the erection of a church for the parish, at an approximate cost of $60,000. Tenders will be called later in the year. Stone, steel and concrete construction.

Union-on-the-Lake, Ont.
J. C. Pennington, La Belle Building, Windsor, is preparing new plans of the proposed addition to the hospital for the Essex County Health Association, and will receive tenders until June 18th. Approximate cost, $15,000.

Wallaceburg, Ont.
The Y.M.C.A. contemplate remodelling their premises, at an approximate cost of $8,000. Particulars from Rev. R. T. Hanley.

Winnipeg, Man.
The Provincial Department of Public Works will shortly call for tenders on the completion of the Parliament Buildings. Estimated cost, $3,000,000.

CONTRACTS AWARDED

Bathurst, N.B.
The contract for carpentry, metal work and roofing required in the erection of a Church and Sunday School for St. Luke's Presbyterian Church has been let to H. & D. Harquil, Campbellton, N.B.

Calgary, Alta.
The Separate School Board have awarded the general contract for the erection of a school to Rogers Brothers, Calgary. Approximate cost, $15,000. Brick construction.

Carman, Man.
The general contract for an addition to the Hospital has been awarded to Snyder & Sutherland. Approxicate cost, $6,000.

Casselman, Ont.
The general contract for the erection of a church for the Parish has been awarded to Merkley Brothers, Casselman. Approximate cost, $6,500. Brick veneer construction.

Fassett, Que.
The general contract for the erection of a church for the Parish has been let to Daoust & Belanger, Alfred, Ont., at $29,000.

Meyroone, Sask.
The contract for the erection of a school for School District No. 3189 has been awarded to Frank Rooney, Weyburn, at $7,725.

Montreal, Que.
In connection with the construction of a church basement for the Trustees of St. Jean Berchmans, the plastering contract has been let to G. Rochefort, 108 Stadacona Street, and the interior fittings work to the general contractor.

The contract for electrical work required in the erection of a Presbytery for the Roman Catholic Parish of St. Catherine, has been let to L. Oritz, 376 Fabre Street.

The contract for steel required in the erection of a school on Robin Street for the Roman Catholic School Board, has been awarded to the Trussed Concrete Steel Company, 59 Beaver Hall Hill.

Moose Jaw Sask.
The general contract for the erection of Providence Hospital has been awarded to William Cowlin & Son, Can-

Tenders and For Sale Department

Tenders for Motor Tractors and Fire Apparatus

Tenders addressed to the undersigned will be received by registered post only up to noon on **Tuesday, June 20th, 1916**, for the supplying of the following:

3 Motor Combination Hose and Chemical Engines.

1 Motor Tractor for Hook and Ladder at Ossington Avenue Fire Hall.

1 Motor Truck for delivering supplies and hauling coal for fire engines.

1 Motor Combination Salvage and Chemical Truck.

1 Motor Hook and Ladder Truck.

Specifications of the above can be seen and forms of tender obtained upon application at the office of the Fire Department, Adelaide Street Fire Hall, Toronto. The usual conditions relative to tendering as prescribed by City By-law must be strictly complied with, or the tender will not be entertained. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman Board of Control.

24-24

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Riding School, Royal Military College, Kingston, Ont.," will be received at this office until 4 p.m., on **Wednesday, June 14, 1916**, for the work mentioned.

Plans, specification and forms of contract can be seen and forms of tender obtained at the office of Messrs. Power and Son, Architects, Kingston, Ont. Thos. Hastings, Clerk of Works, Postal Station "F," Toronto, Ont., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, May 30, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—45139. 23-24

Tenders Wanted

Sealed bulk and separate tenders addressed to the undersigned will be received up till five p.m., **June twenty-fourth, 1916**, for the several works required for the erection of a new School Building in Selkirk, Ontario. Each tender must be accompanied by a certified cheque for ten per cent. of the amount of tender, which will be forfeited should the contractor refuse to sign contract and complete the same.

Plans and specifications may be seen at the office of the undersigned or at the office of the Architect, A. W. Peene, 107 Clyde Block, Hamilton, Ontario. The lowest or any tender not necessarily accepted.

J. E. HOOVER, Sec.-Treas.,
Box 18, Selkirk, Ont.

June 1st, 1916. 23-25

THE PAS, MAN.

Sealed tenders, registered and endorsed on the envelope, "Tender," and addressed to H. H. Elliott, M.D., Secretary-Treasurer of the Town of The Pas, Man., will be received up to 6 p.m., **June 22, 1916**, for the supply and delivery of the following machinery and materials:—

Tender "A"—For the supply and delivery of two Sewage Lift Pumps.

Tender "B"—For the construction of a Sewage Lift Chamber.

Marked cheque for five per cent. (5 p.c.) of the amount of the tender must accompany each bid. The lowest or any tender not necessarily accepted.

Plans and specifications may be seen at the office of the Consulting Engineers, Saskatoon, Sask.; the Resident Engineer, The Pas, Man.; Tender "A" only at Contract Record, Toronto, Winnipeg, and Montreal.

MURPHY & UNDERWOOD,
Consulting Engineers,
Saskatoon, Sask.

H. H. ELLIOTT, M.D.,
Secretary-Treasurer,
The Pas, Man.

22-24

TENDERS

For the Construction of Ashdale Avenue Pedestrian Subway under the G.T.R. Tracks

Tenders will be received through registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to noon on **Tuesday, June 20th, 1916**, for the construction of the concrete abutments, roof slabs, floor, etc., of the above pedestrian subway.

Envelopes containing tenders must be plainly marked on the outside as to contents.

Specifications and forms of tender may be obtained upon application at Room No. 311, Department of Works, City Hall, on payment of ten dollars ($10.00), this sum to be refunded upon return of plans.

Tenderers must comply strictly with conditions of City By-law as to deposits and sureties as set out in specifications and forms of tender.

The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman, Board of Control.

24-24

Tenders for Debentures

Sealed tenders will be received by the undersigned up to 8 o'clock p.m. on **June 27th, 1916**, for the purchase of $15,000 6 per cent. Debentures of the Corporation of the Village of Elmira, under By-law No. 366. No tender necessarily accepted.

J. H. RUPPEL,
Clerk.

24-25

Department of the Naval Service

Tenders for Hatchery and Dwelling

Sealed tenders addressed to the undersigned and endorsed "Tender for Hatchery and Dwelling" will be received up to 12 o'clock noon on **Tuesday, June 20**, for the Construction of a

Fish Hatchery and Dwelling at Kingsville, Ont.

Forms of tender, specifications and all necessary information may be obtained by application to the undersigned. Plans and specifications will be exhibited at the office of the District Engineer, Public Works Department, Windsor, and the Postmaster, Kingsville, Ont.

Tenders must be accompanied by an accepted cheque payable to the Honourable the Minister of the Naval Service for One Thousand Dollars ($1,000.00). This will be held for forfeit if the party tendering fails to enter into the contract if called upon to do so, or in any way fails to properly fill same.

G. J. DESBARATS,
Deputy Minister of the Naval Service.

Department of the Naval Service,
Ottawa, May 27, 1916.

Unauthorized publication of this advertisement will not be paid for. 23-24

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Supplying Coal for the Dominion Buildings," will be received at this office until 4 p.m. on **Wednesday, June 28, 1916**, for the supply of coal for the Public Buildings throughout the Dominion.

Combined specification and form of tender can be obtained at this Department and on application to the caretakers of the different Dominion Buildings.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so or fail to complete the contract. If the tender be not accepted the cheque will be returned.

By order,

R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, June 7, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 24-25

Notice to Contractors

Order No. 1565

Concrete Pavements

Sealed tenders will be received addressed to the Chairman of the Board of Works, City Buildings, St. Catharines, Ont., up to 5 o'clock p.m. of **Thursday, June 22nd, 1916**, for the construction of approximately 13,800 square yards of Concrete Pavements.

Plans, specifications and a list of the streets may be seen at and forms of tender obtained from the office of the City Engineer. Envelopes containing tenders must be marked as to contents. All tenders must be accompanied by a marked cheque for 5 per cent. of the amount of the tender, together with the names of two personal sureties or the bond of a guarantee company approved by the City Treasurer.

The lowest or any tender is not necessarily accepted.

W. P. NEAR,
City Engineer.

24-24

Extension of Time

TENDERS

Sealed tenders will be received up to 6 p.m. of **Thursday, June 22, 1916**, by the Secretary, for the erection and completion of a six-room school building to be built in Parry Sound, Ont., for the Parry Sound Public School Board.

Plans and specifications may be seen at the office of the Secretary-Treasurer, Parry Sound, Ont.; the office of the Contract Record, 347 Adelaide Street West, Toronto, Ont., and at the office of the Architects, Angus & Angus, Angus Block, North Bay, Ont.

The successful contractor will be required to furnish a satisfactory guarantee.

The lowest or any tender not necessarily accepted.

J. D. BROUGHTON,
Sec-Treas., Parry Sound Public School Board,
Parry Sound, Ont.

24-25

Tenders for 8-in. Water Meter

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, July 4th, 1916**, for the supply and delivery of

8-in. Water Meter—Tender No. 47.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor.
Chairman, Board of Control.

24-24

FOR SALE

Marion Revolving Shovel, Model No. 30, on railroad trucks, in fair condition. Box 413, Contract Record, Toronto, Ont. 23-25

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

Plant For Sale

1 Smith Concrete Mixer	$100
1 Wettlaufer Mixer with Engine	250
1 20-H.P. Upright Hoisting Engine	450
2 10-H.P. Motors, D.C. each	85
1 30-H.P. Motor, D.C.	150

HOLMES, 1107 Yonge Street, Toronto. 22-t.f.

ada, Ltd., Mail Building, Toronto. Approximate cost, $100,000. Architect, R. G. Bunyard, 323 Hammond Building.

North Ridge, Ont.
The Public School Trustees have let the general, carpentry, roofing, and painting contract for the erection of a school to Oxley Brothers, Kingsville; masonry and plastering to Frank Brown, Essex, and heating and plumbing to Pennington & Brian, 47 Sandwich Street W., Windsor. Approximate cost, $5,000.

Quebec, Que.
In connection with the erection of a building for the Commercial Academy, Cook Street, the plumbing and electrical work has been let to F. Gingras, St. Augustin and d'Aguillon Streets.

Work has been started on the erection of an annex to the school at St. Eustache and St. Joachim Streets, for the Protestant School Board. The masonry work has been let to A. Fackney, 107 St. Joachim Street. Estimated cost, $10,000.

Radisson, Sask.
The general contract for the erection of a school has been let to McLeod & Arrand, c/o. R. M. Thompson, Architect, Masonic Temple, Saskatoon. Approximate cost, $14,000.

St. Raphael D'Aston, Que.
The general contract for the erection of a Presbytery for the Parish has been let to Cie Ouvriere, Aston Junction. Subcontracts will be let for concrete work and roofing. Approximate cost, $8,000.

St. Thomas, Ont.
The following contracts have been let for the erection of a mission building for the Centre Baptist Church: masonry, A. E. Ponsford, 605 Talbot Street; carpentry, E. S. Hatch, 112 Centre Street; plumbing, J. W. Blanchard, 632 Talbot Street; plastering, C. H. Lea, 257 Ross Street; painting, Charles Loomis; electrical work, Ingram & Davey, 468 Talbot Street.

Windsor, Ont.
The contract for steel required in the erection of an addition to the College has been awarded to the Canadian Bridge Works, Walkerville; heating, plumbing, and sheet metal work to Windsor Hardware company, 71 Sandwich Street E., and electrical work to McNaughton & McKay, 216 Wyandotte Street E.

Business Buildings and Industrial Plants

Brockville, Ont.
John McGaw contemplates the erection of a garage, and plans are being prepared by A. S. Allaster, King Street. Hollow tile and brick construction. Estimated cost, $5,000.

The Fulford Block is to be repaired at once, at an approximate cost of $20,000. Trustees, Toronto General Trusts Corporation, Bay Street, Toronto.

Calgary, Alta.
Work has been started on razing existing buildings on Eighth Avenue W., preparatory to the erection of stores, estimated to cost $30,000. Architect, M Fordyce. Work by day labor.

M. Rumley Company, 403 Beveridge Building, are contemplating the erection of a warehouse, estimated to cost $20,000. Brick and steel construction. Estimates are now being submitted by private contractors.

Delhi, Ont.
Wesley Griffin is considering the erection of a livery barn, to replace that recently destroyed by fire. Approximate cost, $3,500.

Hamilton, Ont.
Plans have been prepared for a block of stores to be built by A. Krukomski, 62 Imperial Street. Brick and concrete construction. Estimated cost, $4,000.

Lindsay, Ont.
The Grand Trunk Railway propose to build a roundhouse, machine shop, etc., at an approximate cost of $20,000. Acting Superintendent, J. D. McMillan, Belleville.

Logan Township, Ont.
John Shean, Logan Township, Mitchell, is considering the erection of barns and a house estimated to cost $4,500.

McGregor, Ont.
C. H. Leslie, Amherstburg, contemplates the construction of a plant for the manufacture of brick and tile. Approximate cost, $6,000.

New Westminster, B.C.
The Canadian Products Ltd., Ladner, B.C., propose to build an evaporating plant, estimated to cost $30,000.

The Brunette Saw Mills Company intend to rebuild their dry kiln, which was recently destroyed by fire. Estimated cost, $4,000.

Ojibway, Ont.
The Canadian Steel Corporation, Ltd., propose to construct a steel manufacturing plant, and work has been started by the Essex Terminal Railway on laying ten side tracks into the property. Docks, wharves, warehouses, and mills will be built, at a total estimated cost of $20,000,000.

Oka, Que.
The Trappist Fathers propose to rebuild their barn, which was recently destroyed by fire. Approximate cost, $50,000.

Ottawa, Ont.
J. A. Ewart, Booth Building, Sparks Street, has prepared plans for an addition to an office building for Jackson Booth, Booth Street. Stone and steel construction.

Pembroke, Ont.
The Pembroke Electric Lighting Company are having plans prepared for a sub-station. Engineer, R S Kelsch, Power Building, Montreal.

Sarnia, Ont.
Tenders are now being received for the erection of an office building for the H. Mueller Manufacturing Company, Ltd. Architects, Prack & Perrine, Lumsden Building, Toronto. Steel, hollow tile, Roman stone and brick construction. Approximate cost, $12,000.

Saskatoon, Sask.
The erection of a store is being considered by Harry Greenway, c/o. Saskatoon Drug Company. Approximate cost, $4,000.

St. Boniface, Man.
A permit has been issued to Lady Joseph Dubuc, St. Boniface, for the rebuilding of a business block at Provencher and Tache Streets. Estimated cost, $35,000.

Toronto, Ont.
A. Walker, 169 Lauder Avenue, has commenced the erection of a block of stores and apartments, estimated to cost $6,000. Smaller trades will be let. Brick construction.

The Board of Control have had plans prepared for stables to be built at Ramsden Park, and will call for tenders shortly. Estimated cost, $38,000. Brick construction.

D. H. Burnham, 983 St. Clarens Avenue, has prepared plans of a block of stores for J. A. Russell, 1514 Euclid Avenue. Brick construction. Approximate cost, $6,500.

The Ideal Bread Company, 183 Dovercourt Road, propose to build a bakery at an estimated cost of $3,000, and have had plans prepared by Bond & Smith, 15 Wilton Avenue. Brick construction.

CONTRACTS AWARDED

East Royalty, P.E.I.
John Agnew has let the contract for the construction of a frame barn to Ernest Parkman, Charlottetown. Estimated cost, $3,000.

Hamilton, Ont.
In connection with the erection of a block of stores and apartments for J. A. Morrow, 217 Caroline Street S., the painting has been let to C. E. Wheeler, 179 King Street W., and heating and plumbing to T. Allison, 226 Duke Street.

London, Ont.
The general contract for the erection of a warehouse for Webster & Harvey, Richmond and Oxford Streets, has been let to Hyatt Brothers, 288 Egerton Street. Estimated cost, $12,000.

Longueuill, Que.
The contract for steel work required in the erection of an addition to the rolling mills of Armstrong Whitworth of Canada, Ltd., has been awarded to the Dominion Bridge Company, Lachine, Que., masonry to J. Quinlan & Company, 4412 St. Catharine Street, Montreal, and machinery to Morgan Engineering Company, Alliance, Ohio. Approximate total cost, $750,000.

Montreal, Que.
The contract for masonry required in the erection of a business building for Verrett, Stewart & Company, Ltd., 12 Port Street, has been awarded to G. Whiting, Sussex Avenue.

The general contract for alterations to a store for the Estate Perreault, c/o. J. Hyde, 205 St. James Street, has been let to W. M. Irving, 26A Stanley Street; painting to Fryer & Matheson, 1475 Clarke Street; plumbing to J. Colford, 450 Guy Street; electrical work to Vincent & Say, 25 Union Avenue. Approximate cost, $7,000.

The contract for electrical work required in the erection of an office building for Lymburner Ltd., 515 Commissioners Street, has been let to W. J. O'Leary & Company, 36 Recollet Street. Remainder of work by general contractors.

The following contracts have been let in connection with the stores and residences now in course of erection for Mrs. P. Bourdon, 478 Demontigny Street: masonry, O. Archambault, 610 Parc Lafontaine Street; concrete work, O. Lageurre, 1723 Des Erables Street; plastering, A. Morache, 499 St. Andre Street; heating and plumbing, J. E. Hardy, 666 Papineau Avenue; electrical work, Lafreniere & Bissonette, 377 Fifth Avenue, Rosemount.

North Vancouver, B.C.
The Wallace Shipyards, Ltd., Esplanade Street E., have let the contract for the first additional unit to their plant to T. Allan, Lynn Valley. Howe truss construction.

Ottawa, Ont.
In connection with the carriage shop now being built by S. W. Halliday, 20 Arlington Avenue, the contract for roofing has been awarded to J. C. Saunders, 169 Fifth Avenue, and electrical work to W. R. McCallum, 525 Bank Street.

In connection with the power station now being built for the Imperial Realty Company, the carpentry contract has been awarded to J. & C. Low, 358 Lisgar Street.

Port Arthur, Ont.
The general contract for alterations to stores and apartments for G. Drewry, Kenora, has been awarded to R. Hamer, 214 Park Street; heating and plumbing to Y. Marshall, and electrical work to Mahan Brothers, 106 May Street.

Quebec, Que.
The general masonry and carpentry contract for enlarging the premises of N. E. Papillon, 358 St. John Street, has been let to L. Boivin, Regd., 202 Richelieu Street. Roofing, plumbing, heating and electrical work will be sub-let by general contractor. Approximate cost, $7,000.

Work has been started on repairs and alterations to the premises of J. B. Giroux, 394 St. Joseph Street. The general, masonry, and carpentry contracts have been awarded to T. J. Cote, Regd., Garneau Boulevard, Limoilou. Approximate cost, $8,000.

The sub-contract for carpentry required in the conversion of a building into a bank for Caisse d'Economie, has been let to T. J. Cote, and roofing, heating, plumbing, and electrical work to Jobin & Paquet, Abraham Hill.

The general contract for the erection of a store for E. & G. A. Carette, 100 St. Paul Street, has been awarded to Emile Carette, 469 St. John Street. Approximate cost, $25,000.

Saskatchewan Province.
The Canadian Pacific Railway Company have awarded the contract for construction of three stations in the Shaunavon Sub-division, to A. G. Creelman, 83 Crown Bank Building, Calgary. Estimated cost, $3,700 each.

St. Thomas, Ont.
The contract for masonry required in alterations to an office building for A. S. Smith, Palace Livery, has been let to A. Horton, carpentry to W. C. Vanhorn, and plumbing to G. W. Blanchard, 632 Talbot Street.

Toronto, Ont.
Bowles Lunch, Ltd., have let the general contract for the erection of a bakery to W. T. Joy, 86 High Park Avenue. Brick construction. Approximate cost, $20,000.

Work has been started on the erection of a factory for Carhartt Hamilton Manufacturers, Ltd., 535 Queen Street E. The masonry contract has been awarded to Weale & Son, 18 Applegrove Street, and the carpentry to Hudson & Mosley, 5 Jerome Street. Approximate cost, $5,000.

F. G. Soper Company, 200 Laughton Avenue, have let the contract for the erection of a warehouse to Tomkin & Baskerville, 490 Oakwood Avenue. Brick construction. Approximate cost, $4,000.

The contract for heating required in connection with the erection of a store and bakery for the Standard Box Lunch has been awarded to W. Schulkins, 932 College Street; plastering to C. Gibson, 37 Olive Avenue; painting to Babbington Brothers, and galvanized iron work to Perkins & Burrows.

A. & A. Grant, 837 Logan Avenue, have been awarded the general contract for the erection of a factory for the Ideal Bedding Company, 10 Jefferson Avenue. Approximate cost, $3,000. Brick construction.

Vancouver, B.C.
The contract for rebuilding the wharf and plant of the New England Fish Company has been let to Cotton Company, Ltd., False Creek. Approximate cost, $150,000.

Welland, Ont.
In connection with the stores now in course of erection for Walter Stayzer, the masonry has been let to James Speedie, and electrical work to G. Reid & Company.

Winnipeg, Man.
The general contract for the erection of a picture theatre for Hyde Brothers, 705 McIntyre Block, has been awarded to John Dolmer, 406 Lansdowne Avenue. Brick, concrete and stone construction. Approximate cost, $35,000.

Residences

Anderton Township, Ont.
The erection of a residence is contemplated by William Cathline, Sinasac Farm, Anderton Township, Amherstburg. Estimated cost, $3,000.

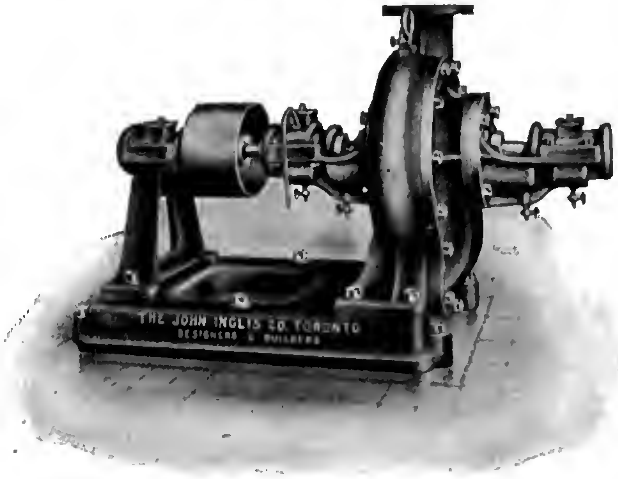
Brockville, Ont.
A. S. Allaster, King Street, is preparing plans of a bungalow for T. C. Dargavel. Hollow tile construction. Estimated cost, $3,500.

Chippewa, Ont.
The Norton Company are now receiving tenders on the construction of twelve single and twelve double residences.

Levis, Que.
L. Auger, 39 St. Jean Street, has prepared plans of a residence for N. Maranda, 14 Deziel Street. Tenders will be called privately. Estimated cost, $8,000.

E. Lacasse, 4 St. Julien Street, pro-

PUMPS



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This Pump is hydraulically balanced against end thrust and in addition has a water cooled thrust Bearing. The Pump is arranged so that it may be operated with guide vanes or without for demonstration purposes. Oil rings, Hydraulic Balance and water cooled thrust bearings are standard for all "Inglis" Turbine Pumps. We make pumps of all kinds for any service.

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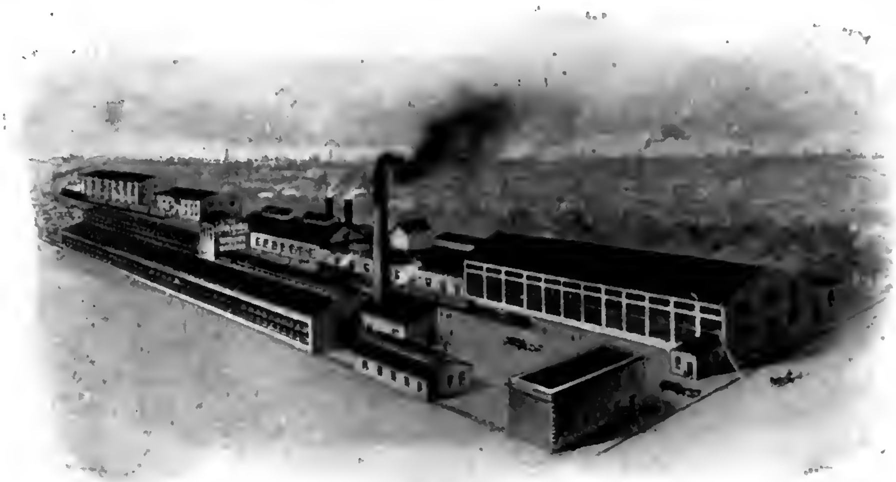

Plant of John Inglis Co., Limited, Toronto

The John Inglis Company, Limited

ENGINEERS AND BOILERMAKERS

14 Strachan Ave., Toronto, Canada

Ottawa Representative:—J. W. ANDERSON, 7 Bank Street Chambers

poses to build a residence at an approximate cost of $6,000, and plans have been prepared by L. Auger, 39 St. Jean Street. Brick construction.

London, Ont.
James Orme, 1010 Waterloo Street, has commenced the erection of a residence on Huron Street, estimated to cost $3,300. Frame and stucco construction.

Medicine Hat, Alta.
George Andrews, Eleventh Street, intends to rebuild his residence, recently destroyed by fire. Estimated cost, $3,000.

Montreal, Que.
V. E. Lambert, 352 Marcil Street, has started work on three flats, estimated to cost $6,000.

J. T. Levasseur, 412 Seventh Avenue, is about to start work on three residences, estimated to cost $4,000. Brick and concrete construction.

The erection of a residence is being considered by H. G. Decarie, 1 Grand Boulevard. Brick and concrete construction. Approximate cost, $3,000.

New Toronto, Ont.
J. A. Gormaly, First Street, Mimico, proposes to build 25 cottages. Work may start immediately.

Ottawa, Ont.
A. H. Bowers, 126 Hopewell Avenue, contemplates the erection of a residence, estimated to cost $4,000. Stucco and brick veneer construction.

Quebec, Que.
Work has been started by F. Cote, Portneuf, on the erection of a residence on Marie Louise Street. Frame and brick construction. Approximate cost, $8,000.

George Bolduc, 228 Prince Edouard Street, has commenced the erection of a residence, estimated to cost $3,000. Frame and brick construction.

The erection of a residence has been started by Charles Lax, 60 Bridge Street. Frame and brick construction. Estimated cost, $4,000.

E. Laberge, Canardiere Road, has commenced the erection of a residence, estimated to cost $5,000. Frame and brick construction.

E. C. Brochu, 147 St. Cyrille Street, is building a residence on Lockwell Street, estimated to cost $6,000. Brick and concrete construction.

A. Guilbault, 341 King Street, has commenced the erection of a frame and brick residence. Estimated cost, $5,000.

E. Lamontagne, 94 Ninth Street, has started work on a residence, estimated to cost $4,000. Brick and stone construction.

Martel & Beupre, Charlesbourg Road, have commenced the erection of two residences, estimated to cost $12,000. Roofing, plumbing and electrical work will be let.

Stirling, Ont.
Rev. Father O'Reilly, Frankford, Ont., contemplates the erection of a Rectory, at an approximate cost of $8,000. Architect, F. Sheehy, Peterborough.

Toronto, Ont.
W. G. Hunt, Architect, Confederation Life Building, has prepared plans of a pair of residences to be built by I. J. Schooley, 283 Concord Avenue. Brick construction. Approximate cost, $5,200.

L. J. Wookey, 40 St. Joseph Street, is having plans prepared for a residence to be built on Castle Frank Road, at an approximate cost of $10,000. Concrete construction.

Nightscales & Smith, 1880 Queen Street E., have commenced the erection of a residence and will let smaller trades. Estimated cost, $4,600. Brick construction.

W. P. Levack, 519 Roxton Road, has commenced the erection of a residence on Geoffrey Street, estimated to cost $4,700. Smaller trades will be let. Brick construction.

L. J. Wookey, 40 St. Joseph Street, is receiving tenders on the erection of a residence on Castle Frank Road, estimated to cost $10,000. Concrete construction.

Windsor, Ont.
G. Jacques & Company, Boug Block, are preparing plans of twenty cottages for J. C. Peters, 134 Glengarry Street. Estimated cost, $2,600 each. Brick veneer construction.

CONTRACTS AWARDED

Bosanquet Township, Ont.
The general contract for the erection of a residence for James Gordon, Forest, has been let to J. Burch, and the carpentry to D. Clark. Estimated cost, $3,000.

Brigden, Ont.
Alexander Blaikie, Inwood, Ont., is building a residence for John Poland, estimated to cost $3,000. Frame and brick construction.

Eastview, Ont.
E. Latluer is building a residence at Marier and Main Streets, and has let the electrical work to J. Francouer. Frame construction. Eestimated cost, $3,000.

Falmouth, N.S.
The general contract for the erection of a residence for Charles Manning, c/o. Hants County Fruit & Produce Company, has zeen let to E. E. Lawrence, Falmouth. Approximate cost, $3,000.

Hamilton, Ont.
The general, masonry, carpentry, steel and roofing contracts for the erection of a residence for Mrs. Forbes, 29 Arthur Avenue S., have been awarded to Myles Carner, 67 Aikman Avenue. Brick and stone construction. Approximate cost, $4,500.

I. Gillard, 59 Federal Life Building, has let the general, masonry, carpentry and roofing contracts for the erection of six residences to J. A. McCutcheon, Federal Life Building. Frame construction. Approximate total cost, $6,600.

D. Brown, 16 Mulberry Street, has awarded the contract for masonry required in the erection of a residence on Aberdeen Avenue to Isbester Brothers, Stewart Apartments, and carpentry and roofing to Stuart Brothers, Hyde Park Avenue. Brick and stone construction. Estimated cost, $3,300.

William Chiswell, 46 Somerset Avenue, bas let the general, masonry, carpentry, and roofing contracts for the erection of a residence to William Hobbs & Son, 313 Emerald Street N. Brick and stone construction. Approximate cost, $3,500.

Kingston, Ont.
The general contract for the erection of a residence for Mrs. Lappen, 323 Earl Street, has been awarded to Douglas & McIlquham, 510 Brock Street. Brick and stone foundation. Estimated cost, $3,000.

Levis, Que.
The general contract for the erection of a residence for R. Roy, 45 Eden Street, has been awarded to Shink & Frere, Levis. Brick construction. Estimated cost, $12,000.

Listowel, Ont.
In connection with the erection of a residence for A. W. Zurbrigg, the heating has been let to C. Zilliax & Son, Main Street.

Montreal, Que.
In connection with the residence now in course of erection for Beaupre & Fils, 655 St. Paul Street N., the contract for plumbing has been let to Hickey & Aubut, 93 Dominion Street. Carpentry and heating by owners.

H. Brunelle, 122 Prefontaine Street, is building a residence, and has let the masonry to W. Lalaucette, 588 Iberville Street. Approximate cost, $5,000.

Niagara Falls, Ont.
Ingham Brothers, Fourth Avenue, are building a number of residences, and have let the heating and plumbing to William Crawford, Buckley Avenue, and electrical work to Candlish Electric Company, Main Street, Niagara Falls South. Brick veneer construction. Approximate cost, $3,000 each.

Niagara Falls, Ont.
The general, masonry, carpentry, roofing, plastering, and painting contracts for the erection of a residence for W. H. Middleton, Third Street, have been awarded to Ingham Brothers, Fourth Avenue; heating and plumbing to William Crawford, Buckley Avenue, and electrical work to Candlish Electric Company, Main Street, Niagara Falls South. Approximate cost, $3,700.

Ottawa, Ont.
In connection with the residence now being built by A. E. Shaver, 5 Powell Avenue, the contract for heating and plumbing has been awarded to J. T. Blyth, Frank Street, and electrical work to C. C. Gould, 219 Florence Street

The general contract for the erection of a residence for M. Murphy has been let to R. E. McKinstrey, 91 Second Avenue. Brick veneer construction. Approximate cost, $4,400.

The contract for heating and plumbing required in the erection of two residences for A. E. Shaver, 45 Powell Avenue, has been awarded to J. T. Blyth, Frank Street, and the electrical work to C. C. Gould, 219 Florence Street.

Outremont, Que.
The contract for masonry required in connection with the residences being built by J. B. DeSeve, 12 Plateau Street, has been let to M. Paquette, 301 Carriere Street. Remainder of work by owner.

Quebec, Que.
The contract for masonry required in connection with the residence now being built by J. Lafond, 12½ Nazaire Street, has been awarded to A. Poulin, 144 Latourelle Street, and the heating, plumbing and electrical work to R. Chiquette, 210 Queen Street.

In connection with the erection of a residence for Ernest Ross, 56 St. Louis Road, the carpentry has been awarded to L. H. Peters, Ltd., 10 St. Angele

street, and painting to J. M. Tardivel, 4 Cote d'Abraham.

The general contract for the erection of a residence for J. H. Jobin, Normal School Building, has been awarded to A. Fackney, 107 St. Joachim Street. Frame and brick construction. Estimated cost, $6,000.

The contract for electrical work required in the erection of a residence for Robert Jobidon has been let to G. Gobeil, 41 Church Street.

In connection with the residence in course of erection for Gordon Ross, 47 Murray Avenue, the carpentry has been let to L. H. Peters, Ltd., 10 St. Angele Street, and painting to J. M. Tardivel, 4 Cote d'Abraham.

The contract for masonry required in the erection of a residence for F. D. Pare, 205 Third Avenue, has been awarded to J. B. Verret & Son, Limoilou, the roofing, heating, plumbing and electrical work to V. Gauvin, Limoilou, and painting to E. Trepanier, 9 Ste. Agnes Street.

In connection with the residences now being built for Lavoie & Frere, 56 Jeanne d'Arc Street, the painting has been let to S. Bedard, Charlesbourg Road, and heating, plumbing and electrical work to P. Paradis, 263 d'Aguillon Street.

The contract for roofing, heating, plumbing and electrical work required in the erection of three residences for N. Cauchon, 59 Dorchester Street, has been let to P. Paradis, 236 d'Aguillon Street.

In connection with the residence now in course of erection for Dame V. A. Vezina, 23 St. Gabriel Street, the contract for masonry has been let to E. Cote, 360 Richelieu Street, and carpentry to J. Savard, 218 Richelieu Street. Brick and frame construction. Approximate cost, $5,000.

Toronto, Ont.

The general contract for the erection of a residence for G. Warrell, 1482 Bathurst Street, has been awarded to B. Sykes, 1796 Dufferin Street. Brick construction. Approximate cost, $3,700.

D. H. Atkinson, 256 Russell Hill Road, has commenced the erection of a residence and garage for W. J. Neely, 262 Dovercourt Road. Smaller trades will be let. Approximate cost, $8,500.

In connection with the erection of a residence for Mrs. C. Evans, 163 Westminster Avenue, the contract for heating has been let to H. Joseph Harrison, 8 St. Marys Street; plumbing to McNaughton & McKenzie, 1029 Shaw Street; plastering to Routery Brothers, 443 Roxton Road, and galvanized iron to George Sinclair, 307 Clinton Street.

C. M. Welham, 54 Nina Avenue, has commenced the erection of two duplex residences for M. L. Kent, 374 Walmer Road. Brick construction. Approximate cost, $8,000.

A. J. Henderson, 63 Wells Hill Avenue, has let the contract for heating and plumbing required in the erection of apartments on Frederica Street, York Township, to Hears & Lillie, 110 Wright Avenue, and is now receiving tenders on roofing, plastering, painting and wiring. Approximate cost, $8,000.

Westboro, Ont.

A. Jarvis, Bank Street, Ottawa, has started work on the erection of a residence, estimated to cost $3,000, and has let the electrical work to H. H. Sanders, 499 Metcalfe Street, Ottawa. Brick veneer construction.

Westmount, Que.

Anglins, Ltd., 65 Victoria Street, Montreal, have commenced the erection of a residence for H. W. Cowan, c/o. Canada Steamship Company. Brick and terra cotta construction. Approximate cost, $9,000.

Work on the erection of a residence for J. J. Doran, 13 Papineau Avenue, has been started by Anglins, Ltd., Montreal. Brick and terra cotta construction. Estimated cost, $9,000.

Anglins, Ltd., Montreal, are building a residence on Sydenham Avenue for T. C. Isard, c/o. Canada Steamship Company. Estimated cost, $12,000. Brick and terra cotta construction.

In connection with the erection of a residence for the Catholic Commissioners of St. Leo, 360 Clark Avenue, the contract for electrical work has been awarded to Vallee & Hamlin, 1867 St. James Street, and bronze work to Robert Mitchell Company, 64 Belair Avenue.

Anglins, Ltd., 65 Victoria Street, Montreal, have commenced the erection of a residence and garage for W. W. Wilder, 290 St. Catharine Street W. Plastic brick construction. Estimated cost, $15,000.

Woodbury, Ont.

The general contract for the erection of a residence for John Potruff has been let to C. Stephenson. Concrete block construction. Approximate cost, $3,000.

Power Plants, Electricity and Telephones

Beauharnois, Que.

Plans of an extension to the power plant of the Howard Smith Paper Company are being prepared by R. S. Kelsch, Power Building, Montreal.

Crabtree Mills, Que.

The Crabtree Paper Company propose to biuld a power plant and dam. Engineer, R. S. Kelsch, Power Buiiding, Montreal.

Magog, Que.

Plans are being prepared for a power plant and dam to be constructed for the Dominion Textile Company. Engineer, R. S. Kelsch, Montreal.

Montreal, Que.

R. S. Kelsch, Power Building, is preparing plans of a power plant for Belding Paul Corticelli, Ltd., 185 Shearer Street, and of a hydraulic power plant for the Ogilvie Flour Mills Company, Ltd., Youville Place.

Miscellaneous

Toronto, Ont.

The Board of Control will receive tenders until June 20th for the supply of 5-inch paving blocks, vitrified. Specifications at office of the Works Department, City Hall.

The Board of Control will receive tenders util June 20th for the supply of an 8-inch water meter. Specifications at Room 12, City Hall.

Triple Island, B.C.

Tenders on the construction of a lighthouse tower, fog alarm building, and residence will be received until noon, June 26th, by the Deputy Minister of Marine and Fisheries, Ottawa. Plans and specifications at the Post Offices, Vancouver, Prince Rupert, Nanaimo, Union, B.C., and at the Department, Ottawa. Reinforced concrete construction.

Late News Items

Dundurn, Sask.

Tenders on the erection of a school will be received until June 22nd by the Secretary to the School Board, F. Livingstone. Architect, R. M. Thompson, Masonic Temple, Saskatoon. Approximate cost, $12,000.

Galt, Ont.

The Bell Telephone Company, Water Street N., have awarded the general contract for the erection of an exchange on Ainslie Street S., to P. H. Secord & Sons, Toronto Bank Building. Subcontracts will be let. Reinforced concrete, terra cotta, steel and brick construction. Approximate cost, $80,000.

Shawinigan Falls, Que.

The Shawinigan Falls Water & Power Company have awarded the general contract for the erection of fifty cottages to G. B. Mitchell, 509 New Birks Building, Montreal; the contract for plastering to R. D. Clark & Sons, 28 Lincoln Street; heating and plumbing to Whyte & Delaney, 51 City Councillors Street, and electrical work to Vincent & Say, 25 Union Avenue, Montreal. Approximate cost, $2,500 each.

St. Edouard, Que.

The general contract for the erection of a church for the Roman Catholic Congregation has been let to Lavasseur & Fortier, Victoriaville, Que., at $42,000. Stone and concrete construction. Architect, T. Raymond, 43 Carron Street, Quebec.

Toronto, Ont.

Plans have been prepared by J. M. Lyle, Architect, 19 Avondale Avenue, for a bank to be built at Ossington Avenue and Arthur Street for the Bank of Toronto. Brick and steel construction. Estimated cost, $20,000.

The contract for brick work required in the erection of a factory for the T. Eaton Company has been let to Thomson Brothers, 151 Rusholme Road, concrete work to Raymond Brothers, 9 Edgedale Road, and steel work to McGregor & McIntyre, 1139 Shaw Street.

Bulk or separate tenders will be received until June 20th for the erection of a block of stores and residences for G. N. Ferrier, 302 Danforth Avenue. Architect, P. H. Finney, 79 Adelaide Street E. Approximate cost, $12,000.

The Board of Control will receive tenders until June 20th for the construction of asphaltic, concrete, bitulithic, and brick block pavements, concrete sidewalks, and sewers. Plans at office of the Works Department, City Hall.

Winnipeg, Man.

In connection with the Grain Exchange now in course of erection for the Trades Building Association, the general, masonry, carpentry, painting and interior fittings contracts have been let to Carter-Halls-Aldinger Company, Ltd., Union Bank Building; steel work to Dominion Bridge Company, Ltd., Canada Building; roofing to MacDonald Brothers, 276 Burrows Avenue; heating and plumbing to Cotter Brothers, Fort and St. Marys Streets, and electrical work to Schumacher & Gray Company, 386 Donald Street. Approximate cost, $250,000.

The contract for the steel work required in the erection of premises for the Bank of Hamilton has been awarded to the Dominion Bridge Company, Ltd., Canada Building, and the contract for boilers to Vulcan Iron Works, Point Douglas, Winnipeg.

ESTABLISHED 1886

Contract Record and Engineering Review

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Vol. 30 June 21, 1916 **No. 25**

Principal Contents

The Government is Moving

There is at last some slight evidence that our Dominion Government will interest itself in the most effective method of obtaining that half-million soldiers which it authorized some time ago. Since the date of the original announcement by Premier Borden he has been strangely silent, and the average citizen is entirely mystified as to why the present methods of recruiting have been allowed to remain in operation so long. Presumably there is no hurry for more recruits, but even so, that is no reason why such an economically wasteful plan should be tolerated at a time when it is equally as important to conserve our physical energies as our other resources. We probably have no more inefficient piece of machinery in the whole empire to-day than these exhibitions of recruiting efforts on street corners and in our public meetings. Man after man and officer after officer exhausts himself in vain contortions, resulting in one or two offers, generally inelegibles. At best those men respond who have the keenest sense of duty and honor—all too often the very men who can least be spared at home. We shall be glad to learn that Mr. Borden's government has taken this matter of recruiting in hand. Neither the responsibilities of this war nor its inevitable sorrows are fairly, or justly, distributed.

Entirely Satisfactory?

Mr. J. H. Sherrard, of Montreal, the president of the Canadian Manufacturers' Association, which met in convention in Hamilton during the past week, is reported to have expressed entire satisfaction with the manner in which General Hughes has handled the placing of ammunition orders. His exact words are quoted as follows:—

"Canada's debt to the Minister of Militia in connection with the making of munitions will only be fully known when the history of our part in the war is written, but it is a great satisfaction and relief to Canadians generally, that the unfortunate investigation which has interrupted his very urgent duties has cast no shadow upon his integrity."

With the last part of this remark we hope we can agree, though it is surely somewhat humiliating to feel that our standard of public life has reached that stage where the fact that a man is honest is considered sufficient cause for a public platform demonstration. The other statement in this quotation about our debt to the minister in connection with the supply of munitions it is not so easy to endorse. In view of the facts that have been unearthed during the recent investigation in Ottawa, we should not be surprised to learn that this sentence in Mr. Sherrard's address was not greeted with loud and prolonged applause by the other Canadian manufacturers present.

Water Supply for the Sault

The question of a new water supply for the city of Sault Ste. Marie, Ont., has been carefully considered during the past 18 months. Under the agreement made between the city and the private company which assumed the water and light franchises in October, 1914, the city was given permission to continue operation of the pumping plant in the company's building up to December 31, 1915. Provision has since been made for the electrical sub-station required.

On account of the pollution of the St. Mary's River, resulting chiefly from navigation, the Provincial Board of Health will not approve of the further continuance of the water supply from the present intakes. Several other sources have, therefore, been investigated, and in June, last year, a full report thereon was made for the city by Messrs. Alvord & Burdick, consulting engineers, of Chicago. As there was some doubt expressed in regard to the capacity of one of the schemes that was favorably considered, further records have been taken during the past fall and winter, which have shown it to be satisfactory. At a recent regular meeting of the city council a resolution was passed recommending that this supply be developed and that a plebiscite be submitted to the ratepayers in June, for their approval.

This scheme consists of a supply from a small creek, which is fed by copious springs at its head. The proposed pumping station site would be located at a point on the creek at practically the same elevation as the main portion of the city and distant about 4¾ miles from the centre of the waterworks distribution system. The route of the pipe line would be along a road almost in a direct line to the city. About midway between the proposed pumping site and the city, the line passes over a summit, elevation of which is about 200 feet above the main street of the city, where it is proposed to build a reservoir of about three million gallons capacity. The force main to same from pumping station and gravity line therefrom to the city system will probably be 24-in. cast iron pipe.

Vancouver Branch C.S.C.E.

Elsewhere in this issue we publish in condensed form a paper on "Pneumatic Caisson Developments in America," which was read before Vancouver Branch Canadian Society Civil Engineers at a regular meeting of that body held on the evening of April 13th last by Mr. Ernest George Matheson, Professor of Civil Engineering, University of British Columbia. Mr. Matheson while engaged in the practice of his profession in New York some years ago was chiefly engaged with caisson work in connection with the erection of several large bridges and business blocks, and therefore had to deal with most, if not all, of the problems connected with that difficult branch of engineering science. As a result his paper proved of unusual interest to the large number of C. S. C. E. members and university students who made it a point to be present on the occasion.

The above address brought to a close the program of meetings and papers for the winter of 1915-16. The meetings have invariably been well attended and the speakers well worth hearing. The success of the winter series was due very largely to the zeal displayed by the president of the branch—Mr. R. F. Hayward, general manager of the Western Canada Power Company, Limited, Vancouver, who was indefatigable in his efforts to make each meeting more successful than the last.

Faulty Engineering

Much of the faulty construction and imperfect workmanship occurring in many engineering projects can be traced to the incompetence or inability of the engineer in charge. It is regrettable, to say the least, that in much of the work requiring careful and exact supervision, men of inferior capabilities or uncertain experience are chosen as superintendents. It is essentially of prime importance that those in charge of a piece of work should have such engineering training and skill as will be comparable with the technical requirements of the work and such as will ensure the work being up to the standard laid down in the specifications. Road building serves as a particular example to illustrate a case where incompetence and inability result too often in construction of an entirely unsatisfactory nature, where materials are skimped or workmanship is imperfect and where specifications and plans are not followed. Much blame for such a state of affairs is often, of course, due to lack of proper supervision from working foremen, but with a proper engineer in charge, the conditions causing such imperfections will to a large extent disappear.

The selection of an inexperienced or incapable engineer is often due to the omission of definite details in the specifications regarding his experience and ability. There is a tendency in reports on projects requiring technical skill to leave unstated the exact qualifications of those who are to assume the responsibility of the work or who are to be placed in charge of its construction. Often it is merely mentioned that an "engineer" or a "competent engineer" is to supervise, without so much as specifying the nature of his competency and, as is usually the case, the judgment as to this quality is left in the hands of a non-technical board or commission. The result is, as has often been shown, that a person is chosen who is entirely unfit to superintend the job, due, either to a lack of practical experience in the particular branch of work concerned, or to a lack of the requisite technical skill or training.

This matter might be remedied, at least in part, by the inclusion in the report on the work, of a definition of the requirements needed by the engineer, which would indicate the technical standing he must have obtained and the number of years he must have spent in practical supervision or construction. There is a beginning of reform in this regard, for some of the reports on public or private projects have now inserted in them such a clause as leaves no room for incapable management. The general adoption of this would result in the responsibility being placed in men of proper status and would further tend to ensure that the workmanship and materials are up to a much higher standard.

Classification of Road Materials

The subject of the classification of asphaltic and bituminous materials has for some years been the subject of active discussion in the Society for Testing Materials, the American Society of Civil Engineers and other bodies. A similar discussion has been going on in England. A report on this subject by the Engineering Standards Committee has just been issued. The report divides into three groups the materials now used in binding together the stones and other mineral aggregate used to form road crusts and road surfaces: These are:—

(1) The tars and pitches obtained by the destructive distillation of coal or similar substances.

(2) The bitumens and asphalts which are found in nature, or are obtained artificially from asphaltic oils.

(3) Chemical binders, including the Portland and natural cements which owe their cementing value as road binders to chemical action, and which are not dealt with in the present report.

Hitherto, as the "London Surveyor" points out in commenting upon this report, the term "bituminous material" has been loosely applied to tar products, as well as to bitumens and asphalts, but the committee have from the first considered that it was desirable from the road engineer's point of view, to maintain a sharp line of demarcation between the two groups. The views put forward in correspondence from America and by American engineers of standing and experience have been carefully considered, but the committee still adhere strongly to the view that the description "bituminous" should be applied only to the second group.

In England, the first group of road binders, the coal-tars and pitches, have been in use for many years, and as the Road Board in 1911 issued specifications for the tars, tar oils and pitches which they recommend for road purposes, these materials have already, to some extent, been defined by those specifications. The Road Board, early in 1914, issued a second edition of these specifications. Only two classes of tar and one class of pitch are dealt with, and as these specifications—which form part of the report—are of such recent date, the committee recommend that they be adopted provisionally as the British Standard specifications for tars and pitches used for road work.

The committee find that the choice of names for the second group of road binders is a matter of some difficulty. This difficulty is increased by the fact that, whilst it is desirable to obtain the concurrence of the American engineers to the nomenclature and definitions which the committee now propose, the adoption of the American nomenclature for the various materials composing this group would be liable to lead to confusion and misunderstanding in England.

The committee have been very anxious to secure uniformity with American practice, and have carefully and fully considered the definitions adopted by the American Society for Testing Materials, and by the American corresponding members, but it is felt that the definitions now decided on are preferable from the road engineer's point of view, as they are based on those characteristics of the materials which can be most readily verified when employed for road making. In accordance with this view the committee consider that it is desirable to make a sharp distinction between coal tar and paraffin oil derivatives on the one side and native bituminous substances and asphaltic oil residues on the other, and they are therefore unable to accept the American definition of bitumen—which would include the coal-tars.

The committee's report, the full title of which is "British Standard Nomenclature of Tars, Pitches, Bitumens and Asphalts, when used for Road Purposes, and British Standard Specifications for Tar and Pitch for Road Purposes," is obtainable at the price of 5s. 4d. (post free) either from the offices of the committee, 28 Victoria St. S. W., or from the publishers, Messrs. Crosby, Lockwood & Son, Stationer's Hall-court, E.C.

Activity in Ford City

The town of Ford City has let the contract for the pavement on Belle Island Avenue and for a concrete box drain in the alley west of this avenue, estimated to cost upwards of $6,000. In the very near future the contract for sidewalks, estimated to cost upwards of $3,000, will also be let. Additional construction work during the present season will include a new public school to cost in the neighborhood of $50,000, the plans for which are at present in the hands of the architects. Other building work is quite active, more especially in the way of dwelling houses for working men.

Preliminary arrangements have been about completed for the extension of the concrete pavement, about 15 feet in width, from the 3rd Concession Road, Sandwich East, via Seventh Concession Road, and partly along the side of the Pere Marquette Railway, to Oldcastle, on the Talbot Road, in the Township of Sandwich South, a distance of about 4½ miles; construction work is expected to commence shortly.

Storage of Cement

The one necessary factor in preserving cement is to prevent the access of moisture. It does not require direct contact with water to injure cement, but such is the affinity of the material for water that even atmospheric moisture and wall dampness cause it to become hard and lumpy. The effective preventive of spoiled cement is, therefore, to exclude every trace of moisture. All air circulation around or between the sacks should be prevented so that a damp atmosphere will not come in contact with the cement. A false floor of boards laid on blocks or bricks keeps the material away from the ground. It is necessary also to keep it separated from damp walls. Sacks should be packed as closely together as possible so as to present a minimum outside surface to the air. Other things being equal, paper bags are more efficient in preserving cement than cloth sacks, due to the paper absorbing moisture less easily. When well protected in this way with a waterproof covering fixed tightly, cement may be preserved indefinitely. Sacks should not be turned around or changed from pile to pile. If caked, it is better not to break the cake in order that fresh material may not be exposed to the action of the air.

Asbestos Situation in U. S. A.

The embargo placed on the export of asbestos from Canada to other than British or allied countries is already having its effect on the asbestos situation in the United States. Canada is the world's greatest producer of this mineral, most of which was formerly exported to the United States, free of duty. The order-in-council preventing exportation naturally produced an effect on American manufacturers of asbestos products and, although the embargo was modified to allow them to have crude asbestos under guarantees that neither the crude or manufactured material would be re-exported to countries other than those provided for in the original order, there has been some increase and probably will be a further increase in the exploitation of the available supplies in the United States. Increases in production in Arizona and Georgia with promises of similar activities in other parts, although in many cases of low quality, have to a certain extent relieved the loss due to the Canadian embargo.

Lightning Protection of Water Towers

Water towers, on account of their high and isolated positions, are good targets for lightning. The effective protection of such structures was discussed in a report presented at the meeting of the National Fire Protection Association held last month in Chicago. For wood tanks placed on steel towers, an air terminal should be placed on the point of the roof bonded to the top of the tower by a metal conductor, while a ground wire extending well into the damp earth should be bonded to the bottom of the tower. For steel tanks and towers, the air terminal may be omitted. A metal roof may serve as the air terminal with a conductor connecting it to the tower. High structures require at least two ground rods. The bonding should be made by using a plug soldered to the conductor and screwed into a hole in the steel framework so as to make perfect electrical contact.

Plans and specifications are being prepared for a new office building for the Welland Vale Company (38 x 70 ft.), three storeys high, concrete foundation, brick first and second floors, mill construction, modern plumbing, marble and tile work, hot water heating, electric wiring. Tenders close Monday, June 26th. A. E. Nicholson, St. Catharines, is architect.

Province of Ontario Highways

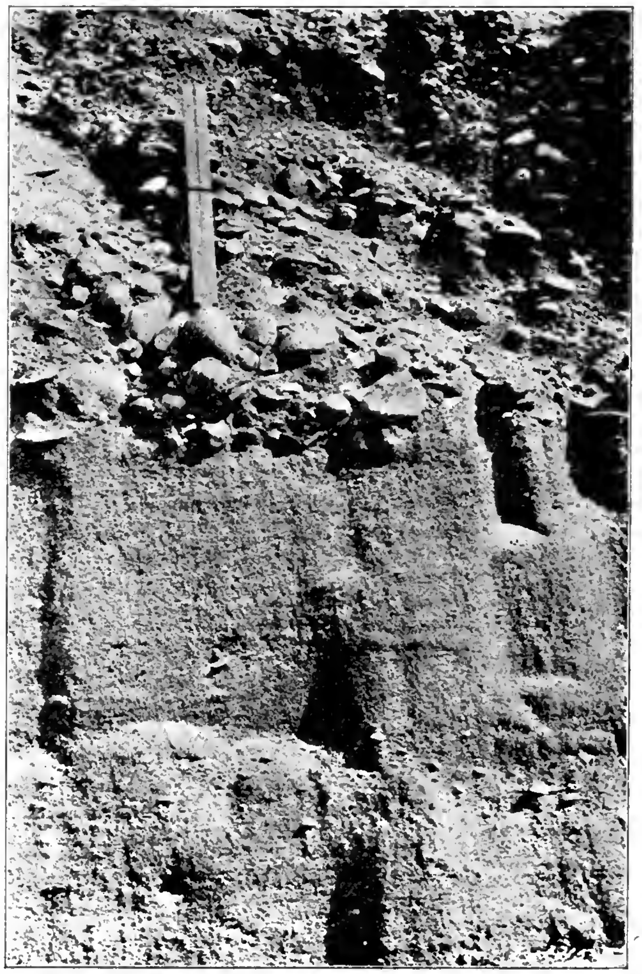
Interesting Descriptions of the Methods Adopted in Constructing, Maintaining and Financing—The City's Share of the County Roads

DEVELOPMENT work on the highways of the Province of Ontario is very fully described in the annual report of the Department of Highways of the Province, prepared by Mr. W. A. McLean, Deputy Minister, and just issued by the Department. The report states that in the province there are 55,000 miles of roadways, of which approximately 20,000 miles are well graded earth roads, 3,000 miles are surfaced with broken stone, and 19,000 miles are surfaced with gravel. The mileage of surfaced roads is considered encouraging, in that, while many are sometimes in a neglected state and often of inferior construction, these will nevertheless respond more readily and cheaply to the systematic attention which it is the desire and aim of the Highways Department of the Province to encourage. The report notes that the building of important market roads under county systems will be of more extended benefit by reason of even moderate improvement of the local feeders.

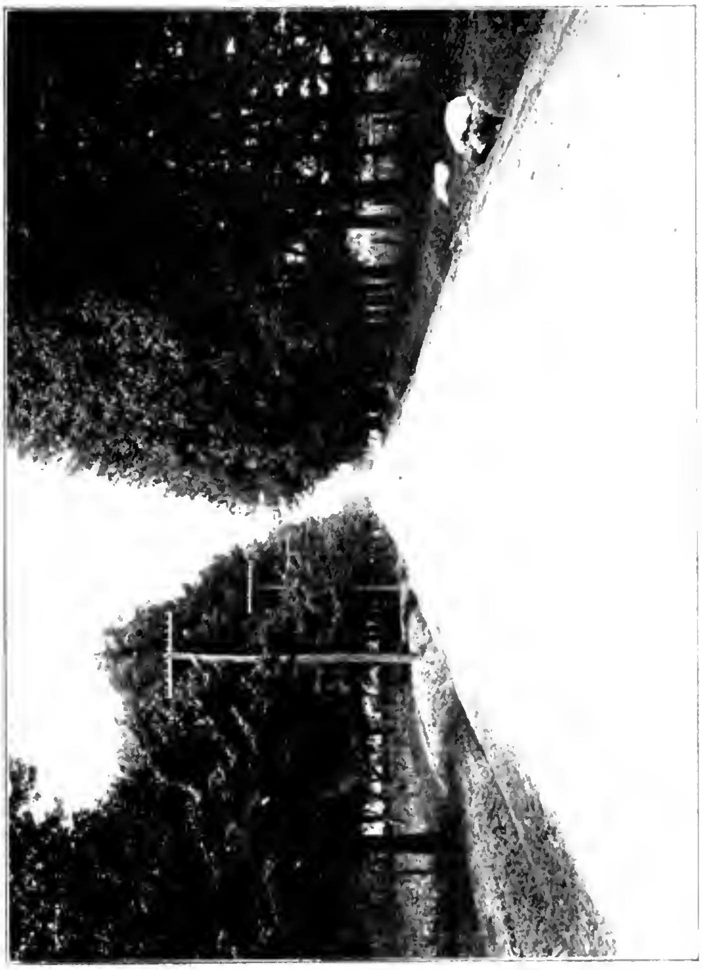
The report deals at length with the expenditures made by the various counties of the province during the past year and the methods of obtaining the money for this work. The cost of county roads is also discussed at considerable length, and it is pointed out how much depends on local conditions. For example, in a number of districts where they have no local material for road making, where the subsoil has to be carefully prepared, freight rates paid and so on, the cost may run anywhere from $4,000 to $8,000 per mile. In other districts, however, where there is an abundant supply of stone close at hand, and where the task of the roadmaker is often only that of regrading or laying a new surface over an old stone or macadam road, the expenditure need not exceed $2,500, or at most $3,500 per mile. Where good gravel is easily available, a substantial roadway can be produced for from $1,000 to $2,000 per mile.

A standard form of construction consists of an earth grade, twenty-four feet between shoulders, outside of which are the open drains. In the centre of the grade is placed, for a "single track" road, gravel or stone to a width of ten feet, and a depth varying from six to twelve inches, according to the traffic, subsoil and existing foundation. Good grading and drainage are of first importance. The road should be rolled with a ten-ton steam roller to complete for traffic. If the road is on an important line of through traffic, or adjacent to a city, the earth grade should be twenty-

Good Gravel Uniform and not too fine. Note foot-rule.

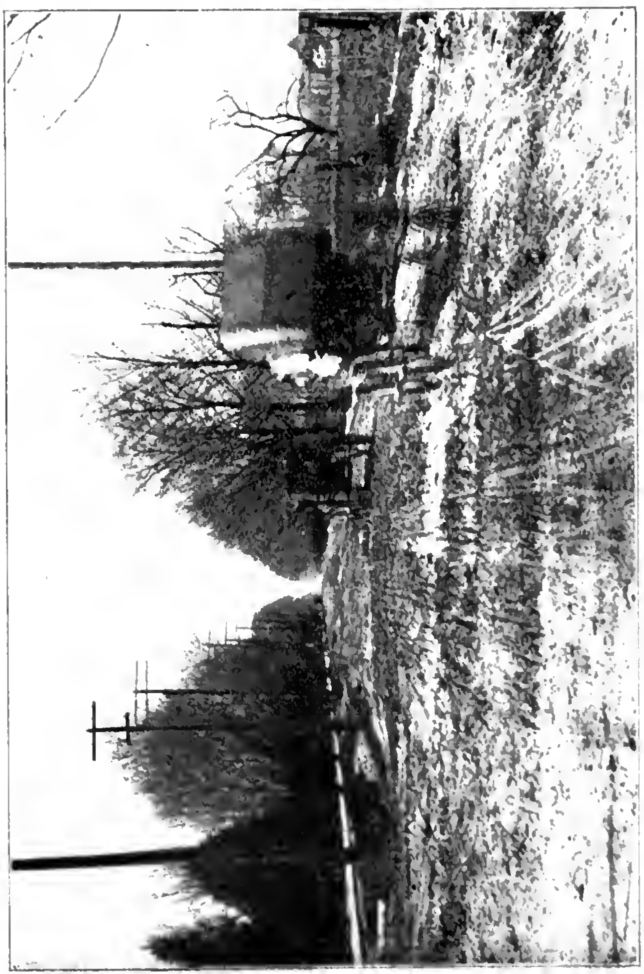


Inferior Gravel Irregular and sandy. Note foot-rule.



Malahide Township Road. Broken stone 18 feet in width, [illegible]
27 feet between ditches.

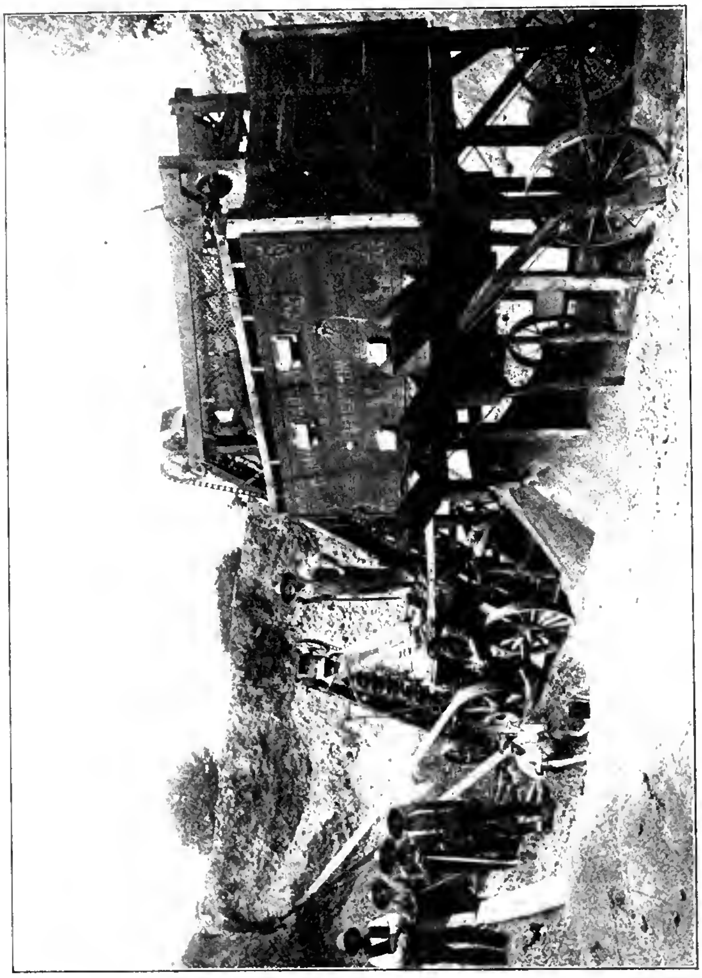
[illegible] Arch Bridge in Huron County [illegible]



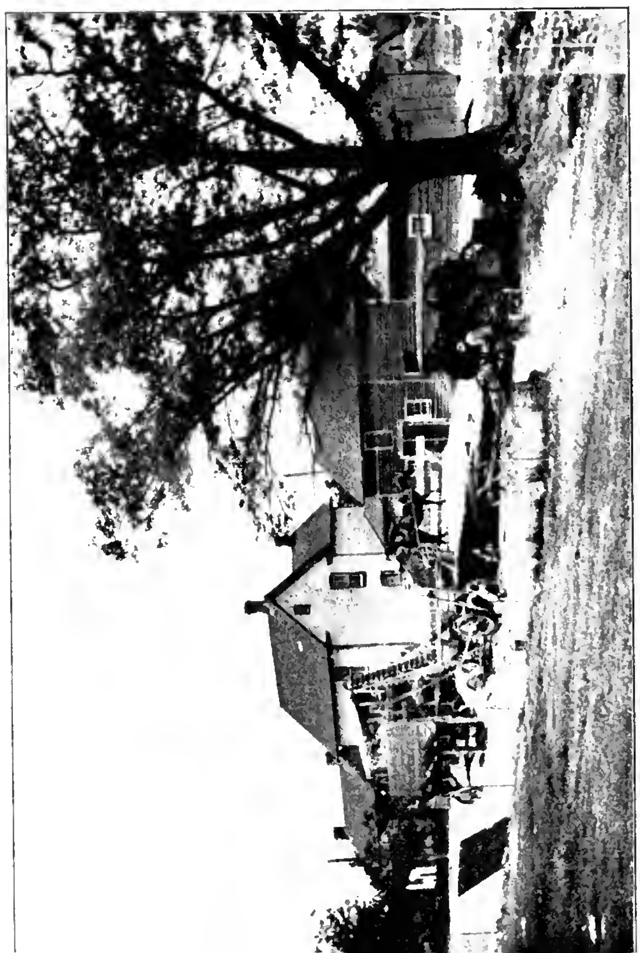
Malahide Township Road, Before Improvement

Ten Foot Concrete Culvert in York County

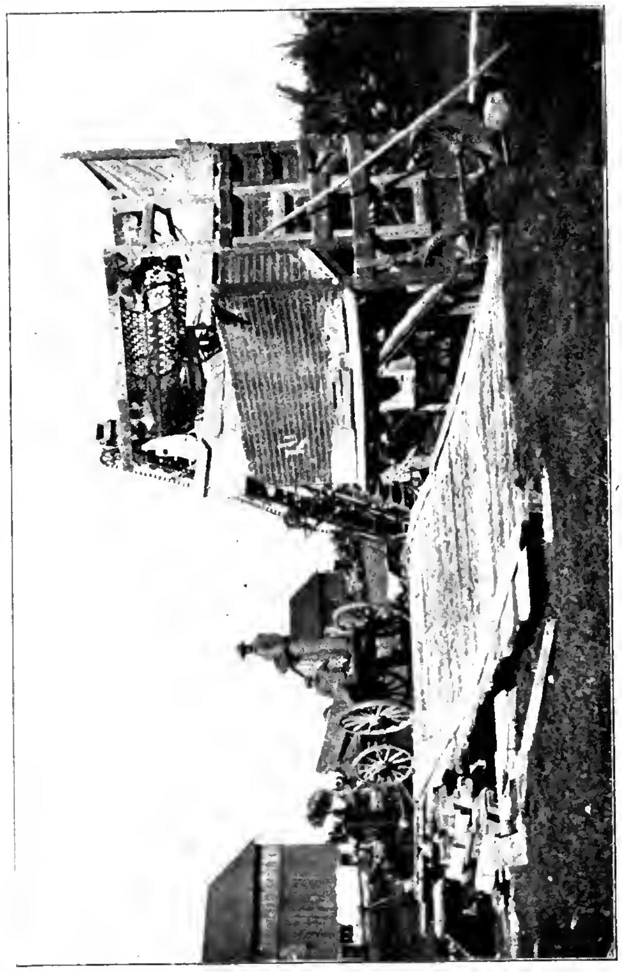
Arrangement of Crushing Equipment—Stone in quarry buckets is raised by a crane to a platform above hopper leading to Crusher.



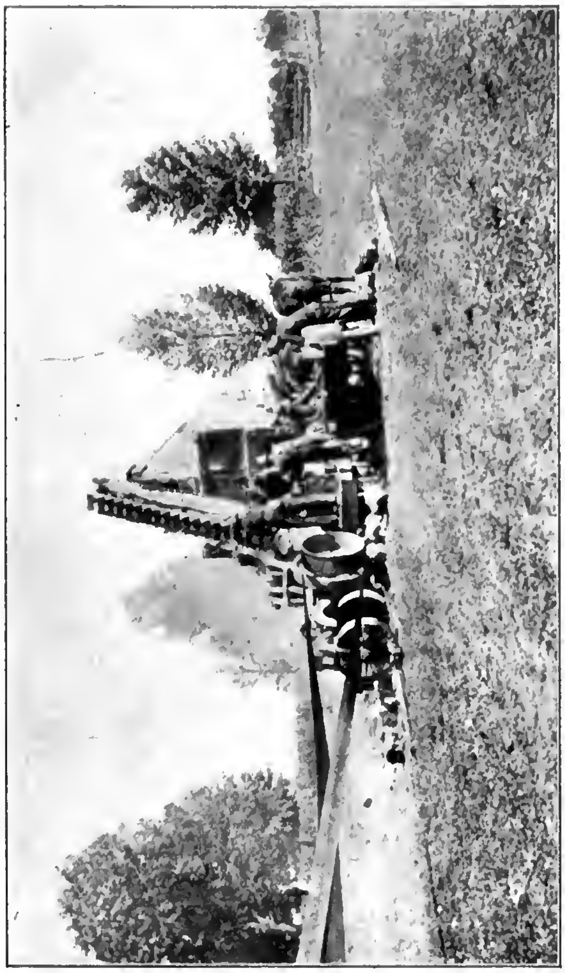
Arrangement of Crushing Equipment. Power from a Traction Engine on top of the bank of gravel; gravel being fed to the Crusher by bucket elevator; material passing through a revolving screen to storage bin.



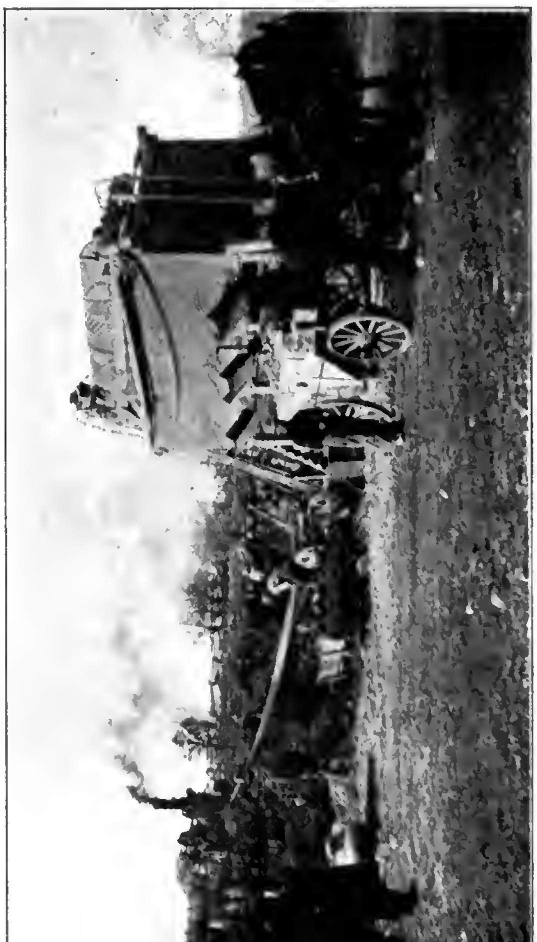
Arrangement of Crushing Equipment—Stone is carried in one-horse carts and is dumped into a hopper from an elevated platform. Three horses and carts are necessary to keep Crusher full.



Arrangement of Crushing Equipment—An elevated platform above Crusher; one team to three wagons; one wagon being emptied; one full; and one being filled.



Arrangement of Crushing Equipment—Inferior method of feeding field stone, being hauled one by one to Crusher, while team is idle.



Arrangement of Crushing Equipment. Stone carried from the quarry face in small cars operated over portable steel tracks.

seven feet wide instead of twenty-four, and provision made for a "double-track" of gravel or stone, eighteen feet wide. This, however, is rarely necessary. A single track of metal nine or ten feet wide may first be laid, and later widened to eighteen feet as traffic increases.

Financing County Road Systems

One of the chief difficulties in the way of better roads throughout the country is the question of financing. The average county council hesitates to add to the tax rate by so many mills on the dollar and often for sentimental reasons they are equally opposed to the issue of debentures for this purpose. On this question of financing county road systems, Mr. McLean's report makes some interesting and valuable suggestions, as follows:—

Alarming but inaccurate statements are met with from time to time as to the cost and debt accruing from county road systems. In financing the work, some counties levy an annual rate on the equalized assessment to meet the yearly expenditure. Others obtain the necessary funds by the issue of debentures. The sentiment of some localities is strongly opposed to the creation of municipal debt; but, by a reasonable compromise, a sound scheme of finance can usually be reached, such as will be practicable, fair, and will not unduly retard progress.

The construction of a system of county roads roads should not be considered solely with regard to the total cost in a term of years, but rather from the standpoint of the annual cost. Road improvement is a process of development which will necessarily extend over a long term of years, and is a perpetual charge rather than a definite capital outlay.

A county rate of 1½ mills on the equalized county assessment should provide a satisfactory annual fund for expenditure on county roads, and should not be beyond the ability or willingness of any county in the province.

For example, to levy a rate of 1½ mills would create an annual expenditure, for each $10,000,000 of assessment, as follows:—

County rate—1½ mills would produce	$15,000
Raised by issue of debentures to meet cost of bridges and permanent construction	6,000
Provincial subsidy, 40 per cent. of total expenditure	14,000
Total for year	$35,000

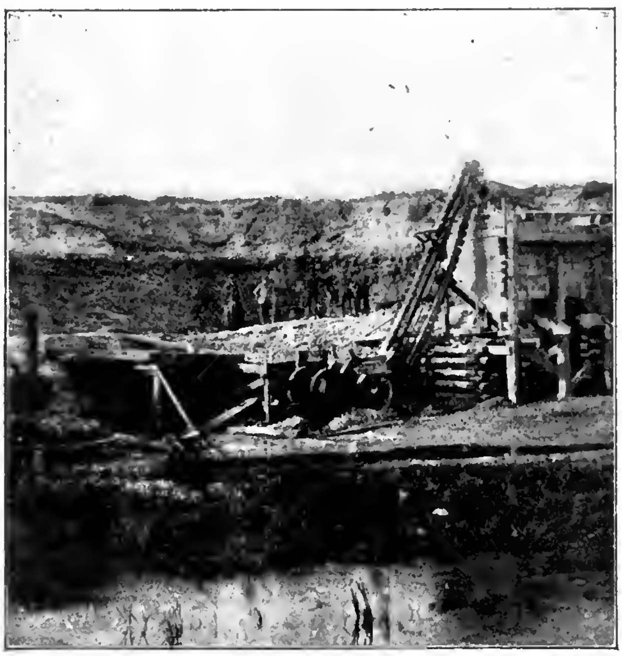
At the end of ten years the net result to the county would be a plan of road improvement representing an asset of $350,000, with a debenture debt of $60,000.

The objection to an annual levy alone is that, without imposing an objectionably heavy tax, insufficient funds are provided; progress is slow, and the gradually increasing demands for maintenance tend to further retard progress of construction. Public dissatisfaction arises from the fact that roads are not being built rapidly enough, maintenance of roads is neglected, and still a substantial tax is being paid. Further, by the annual levy alone, the people of to-day are paying for benefits to which the future should fairly contribute.

The objection to construction solely by the issue of debentures is that property owners of the future may be called upon to pay in part for benefits which they do not receive; while a considerable part is absorbed by interest charges. The sentimental objection to municipal debt is also strong in some localities and must be considered. Further, the immediate improveden of taxation that succeeding councils fear to levy a reasonable annual rate for maintenance. Much depends on the term for which debentures are issued. The Act permits a period of thirty years, but, if confined to ten or twenty years, a sounder basis is attained.

As stated in a previous paragraph, a compromise, a union of the two, an annual levy supplemented by a debenture issue, affords a reasonable and sound method of finance such as will not retard necessary progress, will permit proper maintenance, will not unduly burden the present or future, and will not create an objectionably large municipal debt. By meeting part of the cost of construction by an annual levy, and part by the issue of debentures, the most satisfactory result can be attained. Just what part should be met by the issue of debentures may be estimated from several standpoints, such as: (1) the permanent part of the work; (2) the ultimate cost of maintenance; (3) the ability and willingness of the people of the county to contribute by direct tax.

(1) Certain parts of the work may be considered



Arrangement of Crushing Equipment—Oxford County—Crusher below floor of quarry; limestone fed to hopper over Crusher, and crushed material elevated to revolving screen and storage bin.

permanent, such as concrete bridges, grading, hill-cutting and drainage. The cost of such permanent construction may be estimated, and raised by the issue of debentures; while a further amount to construct, maintain and meet the annual payments on the debentures may be met by annual levy.

(2) The probable cost of maintenance for the completed system may be estimated, and, together with the annual payment on debentures, this sum may be raised as soon as the county system is assumed. The cost of maintenance for the first few years is small, and the difference can conveniently be put into construction, to be supplemented as needed by funds raised by the issue of debentures. As maintenance costs increase, a larger amount will be needed from the debenture fund—but the total debt need be comparatively small.

(3) In case the ability and willingness of the people permit, a still larger sum than is ultimately needed for maintenance may be raised when the system is first assumed, thereby still further reducing the necessary debenture debt.

Broadly, when a county adopts the policy of raising a substantial sum annually (to be supplemented, as required, from debenture issues), the difficulty of financing the work is by no means burdensome, and the method is financially sound above all criticism.

The report futher deals with the highway legislation enacted by the Ontario Legislature at their last session, which has already been dealt with in the Contract Record. In defense of the principle contained in the Ontario Highways Act, that cities should contribute to the construction and maintenance of main roads and leading market roads adjacent to the city, conditions in a number of U. S. states are quoted, as for example, New York, where 85 per cent. of the cost of the state roads is paid by the city of New York; the city of Detroit is paying 85 per cent. of the cost of the concrete roads of Wayne County; the city of Cleveland is paying annually $800,000 for roads outside the city; and the city of Boston is paying 65 per cent. of the expenditure on the state roads of Massachusetts.

An appendix deals fairly completely with the four topics, county road inspection, tests of materials, non-asphaltic road oils, and traffic census statistics. In connection with the report on county road inspection, submitted by assistant engineer W. Huber, a number of very interesting photographs, representing the arrangement of crushing equipment in various counties are shown. Through the kindness of the Highways Department, these photographs, as well as a number of others dealing with roadways' matters, are reproduced in our present issue.

Monastery in Quebec

A contract for the construction of a monastery at the corner of Ste. Foye Road and Bell Avenue, Quebec, has been let to Mr. L. G. Fauteux, St. Benoit, P.Q., the plans having been drawn up by Mr. C. Bernier, Montreal. The building, of five storeys, is on a site 125 x 52 feet, and will be connected by a corridor with a temporary church now existing. The monastery is for the Peres du Tres St. Sacrament, and will cost $82,000. The exterior is of plastic brick, supplied by the Citadel Brick Company, with Deschambault stone trimming; and similar stone will be employed for the exterior up to the first floor. Interior finish and partitions will be of plaster, while the floors are to be hardwood, which will also be used for all other woodwork. The heating will be hot water on the Briset system. On the ground floor will be located the kitchen, dining room, parlor, and reception room; on the other floors provision is made for recreation rooms, library, toilets, chapel and infirmary, the balance of the space being for a large number of bedrooms. A garden roof is also provided.

Milton Pressed Brick Co., Ltd.

A large brick amalgamation has just been completed by which the Milton Pressed Brick Company, Limited, of Milton, takes over the Toronto Pressed Brick Company, of Milton, and the Medina Shale Brick Company, of Streetsville. The new company will be known as the Milton Pressed Brick Company, Limited; capitalized stock $1,500,000. J. S. McCannell is president and managing director of the new company.

This is the Age of Rapid Construction

A Number of Specific Instances Where Modern Methods Aided Speedy Building Operations—A Big Chemical Plant for Quebec

Scattered over a U-shaped area a mile long, covering 460 acres, a great powder plant, costing upward of $1,500,000, was recently completed in five months at Drummondville, Que., by an American firm of engineers and constructors. Two acid-making plants added to the original contract have since been built at an additional cost of $500,000. No unit of the plant was difficult of construction, but the work as a whole required extensive clearing and grading, the construction of seventy-five concrete, brick and timber buildings and a railroad yard, the installation of heavy machinery and the fitting of an extraordinary quantity of pipe.

The plant will be operated by the Aetna Chemical Company of Canada for the manufacture of guncotton and smokeless powder. It is located near the French-Canadian village of Drummondville, Que., which has a population of only 3,000, and which could neither furnish nor house the 2,000 workmen required to push the plant to rapid completion. The powder works will draw water from its own filter plant on the St. Francis River. It is located near a branch of the Canadian Pacific Railway, from which a permanent siding and yard had to be built for the plant.

Plans Made Quickly

The site was selected at the time of the signing of the contract. A preliminary survey was at once made and a general layout established so that construction was actually started within two weeks. The general layout of the plant, which is U-shaped, places the sulphuric-acid plant, nitric-acid plant, cotton stores and cotton dry house in the order named from south to north along the east side. The remainder of the guncotton plant and the press houses of the smokeless powder plant are located on the main east-and-west axis, and the balance of the smokeless plant on the west side.

All the buildings except the pump house, power house and magazines were constructed of timber. The power house is combination brick and timber. The magazines were built with tile walls and reinforced-concrete roofs. All important foundation work is of concrete. The steam, air and alcohol piping has been carried above ground, the high pressure hydraulic lines at the surface in boxes and the water piping in trenches at least 6 feet deep to provide against frost.

Materials Assembled Rapidly

The first task of the constructors on being ordered, July 20, 1915, to proceed with the work, was to assemble at the site the plant and the large quantities of material needed. The plant was loaded immediately at Montreal and reached the site in two days. Having kept in the closest touch with the market, the firm was in a position to place the main orders for material to good advantage at short notice. The capacity of a good-sized lumber mill at Drummondville was investigated, and its entire output was at once contracted for in small-dimension sizes. The large timber was bought at once from Montreal dealers. The entire output of a brick kiln at Mitchell Station, near the work, was bought up. Arrangements were made at Drummondville for the exclusive use of its rock-crushing plant, which, when pushed to capacity, could just supply the job with aggregate, and contracts were made with the local farmers for delivering boulders to be crushed. Good sand in large quantities was found at the site.

Key Structures Attacked First

The detailed design of the plant and the supervision of the construction were carried out by the constructors under the guidance of the Aetna Company's engineers, with the result that the work was harmoniously planned and executed. There was little waiting by the construction forces for plans to be delivered, and all details were worked out in time to have the necessary material at the site when it was needed. Two main features were at once recognized as the keys to the rapid completion of the plant. The first was the railroad yard, which the constructors needed to get in materials and plant, and the second was the power house—a heavy piece of construction which was started at once and finished within 104 days. The grading required was in sand and was not heavy. It and the clearing had to be done immediately, and both were started July 20 with local labor, teams and scrapers. This work was practically completed by September 1. As rapidly as possible a large, well built camp was constructed on the site to care for 2,000 men sent up from Montreal. This was made a permanent camp for the use of the operating forces by the addition of a club house and separate cottages. Meanwhile the railroad yard was partly graded, and the entire three miles of trackage was laid and in use by August 15. Two weeks later the yard had been completely graded and the tracks put in permanent shape.

Difficulties with Water

As soon as possible the foundation work was started. The site was elevated, and it was not expected that water would be found in the excavation for the foundations and the numerous pipe trenches. However, water was encountered in all of this work about two feet below the surface. Pumps were at once secured, and the difficulty was met with hardly the expense of a day's delay. Following the excavating crews were five gangs with portable mixers, supplied by teams, putting in concrete foundations. After them came the crews erecting the timber frames. A very limited use was made of steel in the construction. The future contents of the buildings made fireproofing somewhat superfluous, and the lighter, cheaper construction adopted is considered more economical in the long run. The buildings are spaced widely, and under these conditions are amply protected from fire.

All the buildings are linked by an industrial railway along which the materials are transported in the course of manufacture from the acid plants at one end to the finished smokeless powder at the other. A locomotive crane spotted the cars carrying the equipment of presses, tanks and other heavy apparatus and unloaded them on runways on which the machinery was moved into various buildings before the completion of the outside walls. Wagons were used for transporting all other materials on the job. Only one motor truck was employed, because road conditions were poor. This truck hauled small plant and rush supplies from the Intercolonial Railway, over which a fast express service from Montreal was available.

Mixers, pumps, hoisting equipment, etc., were independent steam units. About 100 horsepower in electric current—all the local company could supply—was used for lighting, and for temporary operation of the permanent pumping station.

Strong Overhead Organization

To secure efficiency from a maximum of 2,300 men drawing wages of $45,000 weekly, a strong organization was necessary. At its head the engineer in charge was responsible, with the help of the main office, for having all designs ready, all materials on hand, all work laid out and orders issued in accordance with the construction schedule. Under him the general superintendent had entire charge of the actual work of creating the plant. His force comprised not less than ten general foremen under whom in turn were foremen in charge of each of a large number of scattered crews. The classes of labor requiring general foremen were the excavating and concrete forces, with two general men; the timber-framing and erection crews, the brick layers, the men engaged in installing the machinery and the pipe fitters. In addition the construction of the yard, power plant, acid plants, and filtration plant were each treated as separate units and put in charge of a general foreman with a complete organization. This system worked well, as the units which were important time factors were in charge from start to finish of one man who was responsible for their completion to schedule, while the main force for the large number of smaller units was kept mobile so that it could be thrown where needed for the greatest economy and speed.

Acid Plants Delay Completion

During the construction it became evident from the growing scarcity of nitric and sulphuric acid that the Aetna Company would have to build its own acid plants. But for this the guncotton end of the plant could have been put in operation November 15, sixteen weeks after the contract was signed, and smokeless powder could have been manufactured by December 15, a month later. The nitric-acid plant, first decided on, was completed early this year, and the sulphuric-acid plant is now being built. The total outlay for the completed plant represents $2,500,000, of which cost the construction work comprised four-fifths. The work was carried out under the direction of the engineering and construction forces of the Aetna Explosives Company by Westinghouse, Church, Kerr & Company, whose representatives were J. H. O'Brien, managing engineer, F. E. Caldwell, engineer in charge, and John Lydon, construction superintendent.

Simpson Mail Order Building

The accompanying illustrations show the progress that has been made on the new mail order building of the Robert Simpson Company on Mutual Street. A general description of the structure appeared in the Contract Record of April 26th. The cuts show the comparative conditions on April 1 and June 1, and demonstrate the rapidity with which Wells Brothers, the general contractors, are advancing the work.

Fig. 1 shows the preparation for excavating the foundations. Owing to the soil being unsuited for a spread foundation for a building of this type, concrete caissons were used, seventy-eight in all, varying in diameter from four to six and one-half feet, and extending 43 to 46 feet to bedrock. An interesting method of reducing the labor in their construction was used, by which it was possible to excavate for thirty-eight caissons at one time. An endless chain was run from the engine shown in the illustration, Fig. 1, up and down through three rows of tripods, back to the engine. This chain was continually moving. As the buckets in each hole were filled by the excavators, they were attached by their rope to the moving chain over the niggerheads which can be seen on the tripods. The buckets were thus pulled up, dumped and then lowered to be again filled. The endless chain covered thirty-eight holes altogether, so that any or all of them could be excavated at one time. Thus by only two settings of the equipment all the caissons were dug, which expeditious method contributed materially to the rapidity with which the work has been carried out. On account of the large amount of water in the sub-soil continuous night and day labor was required until the pouring of the concrete was com-

Fig. 1—Simpson Building, April 1.

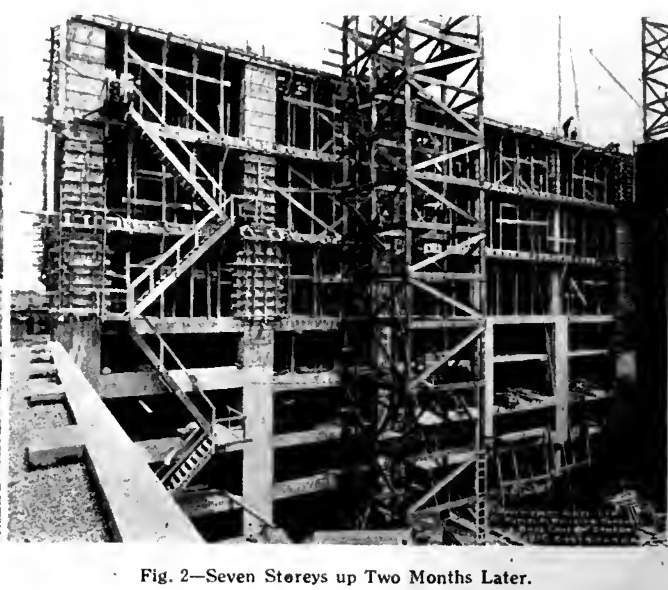


Fig. 2—Seven Storeys up Two Months Later.

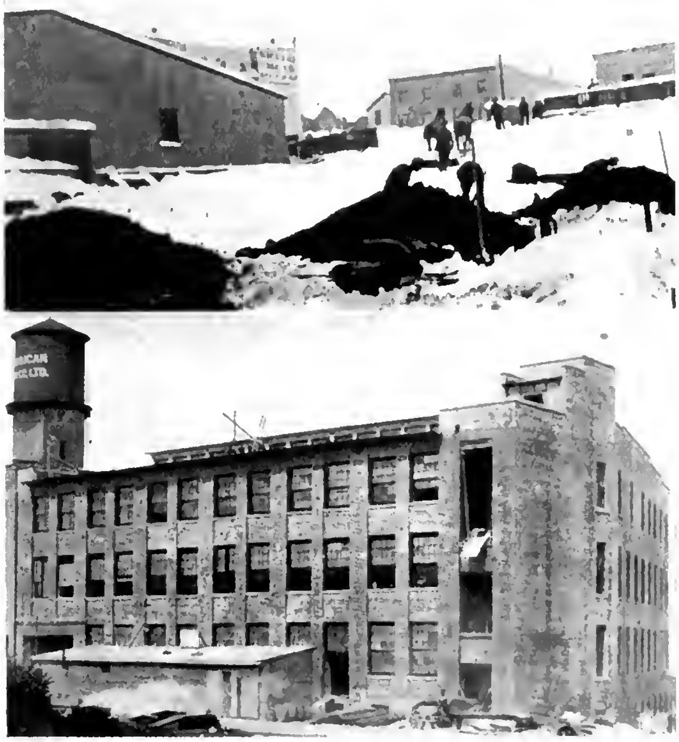
pleted. This prevented any undue accumulation of moisture.

Fig. 2 shows the conditions on June 1 with five floors up. The framework carrying the derrick is shown. This is continually being extended upward as the construction continues, and it serves also as a guide for a hoist.

The building, although as yet far from complete, will, it is expected, be finished this fall. As evidence of the rapidity of the work, the first slab was poured on the 19th of April, and the construction is now at the seventh floor.

Record in Vancouver Building

When the American Can Company, Limited, built their large factory on Railway Street, Vancouver, three years ago, it was with the thought that they would have ample accommodation for a number of years. Such, however, has been the very rapid progress of their business that early this year they found it necessary to arrange for a big extension. On February 3, the contract was let for a three storey and basement addition, consisting of 129 feet frontage by



Upper, Starting Excavation, Jan. 8. Lower, Building Complete March 8.

a depth of 125 feet. The new building will give a floor area of 60,000 feet, and a considerable quantity of this space is immediately required for storage purposes.

The Dominion Construction Company, Limited, Vancouver, made good time on this work. When they started excavating on February 8, the ground was covered with snow, and during a good part of the interval they have been deluged by rain. The carpenters are now busy laying the maple flooring, the concrete basement is under way, and the building will be ready for occupation in a very few days. The floors are of 3-in. fir, covered with factory maple.

New Machine Shop and Power House, St. John

Grant & Horne, engineers and contractors, St. John, N. B., have just been awarded the contract for the erection of a new machine shop and power house for T. McAvity & Sons, St. John. The machine shop will be eighty-one feet wide and 401 feet long. At the front, fronting on Marsh Road, there will be four doors and at the rear two reinforced concrete loading platforms, ten feet wide and forty-seven feet, ten inches long; one will be devoted to receiving raw material and the other to shipping the finished product. Along the rear will run the I. C. R. spur track for handling freight and also delivering coal to the power house. The construction of this building will be of reinforced concrete with hard pine framing inside. Two rows of supporting posts, spaced twenty feet apart longitudinally, will divide the floor space into three bays. The building will be one storey in height with a clear space of sixteen feet to the lower roof beams. The floor will be of reinforced concrete throughout and the structure will be well lighted by steel sash windows on the sides and a saw-tooth skylight in the roof.

The power-house will be built of brick with steel trussed roof, and will be seventy-seven feet, eight inches long and thirty feet wide. It will contain the boiler and engine rooms and will be twenty feet clear height in the engine room and twenty-five feet in the boiler room. The floors will be of concrete and brick. In both buildings the roofs will be of mill construction and a sprinkler fire-protection system will be installed throughout. The foundations will be of concrete and piling, 200 piles being used, and of these seventy will be required to support the chimney stack. The stack will be 150 feet in height, diameter six feet at top, and is to be built of radial brick by Kellogg & Company, of Montreal. The plant used by the Grant & Horne Company for this work, which is now under way, consists of three concrete mixers, each of a capacity of seventy-five yards a day; an engine for hoisting timbers; derrick; two elevator towers; piling engine and pile driver with 2,800 pound hammer. Work is to be completed by August 1.

The same company have just completed a concrete floor on Brown's Mill-dam Bridge at Bathurst, N. B., a raw sugar shed extension for the Atlantic Sugar Refinery at St. John, and have contracts in hand for a concrete floor on the Covered Bridge at Covered Bridge Station, near Fredericton, N. B.

Belt Dressing

There are many dope dressings on the market that should never be used except to ruin a belt. A few dollars more each year for a good dressing will soon save itself in the increased life of the belt. Some substitutes, such as linseed oil, soap, resin, grease, or any old kind of oil have been recommended for the cure of temporary belt slip. It stands to reason that a hard smooth surface will cause the belt to slip. Neats-foot oil and castor oil are often recommended, but they should be discarded in favor of some of the valuable belt dressings on the market. The principle to follow is to keep the belt pliable

The introduction of dust removers in granite sheds has been developed to such a stage of perfection that the fatal dust menace of the workers seems to be in a fair way of being eliminated.

Park Avenue Grade Separation in Montreal

In order to give better facilities in the north end of Montreal, the city has opened the Park Avenue subway, under the C. P. R. tracks between Van Horne Avenue and Lannes Street. Prior to the construction of the subway, pedestrians had to cross a level crossing, and vehicles had to make a considerable detour in order to get to the other side of the tracks. The subway was designed, on instructions from the city, by Mr. J. Emile Vanier, engineer, Montreal, and the contract let in November, 1914, to Laurin, Leitch and Company, Montreal.

The length of Park Avenue is 800 feet, running south and north, and 330 feet on Van Horne Avenue, running east and west. The bridge, 80 feet wide and 17 ft. 5 in. from the ground, carrying the C. P. R. tracks, is a heavy steel structure, with sidewalks on either side and reinforced concrete panels, pilasters, etc., hiding the steel work and at the same time carrying the architectural lines from the retaining walls and along the bridge. The retaining walls, with panels and pilasters, are crowned with an ornamental balustrade, the whole being in concrete. The distance between the retaining walls is 66 feet, while the roadway is 50 feet wide; there are double lines of street railway tracks, and steel trolley poles between these on the roadway. The paving is of scoria blocks. It was found necessary to divert the sewer and water pipes from the centre of Park Avenue; these are now situated on a side street to the west of that thoroughfare, the city having expropriated land for this purpose. The surface water running down the subway is collected by means of a system of gullies and a collecting wall, from which it is pumped by an automatic electric pump into the new sewers.

On the southwest corner stone steps lead from the roadway to the sidewalk, the ground there being on a higher level. These steps give access to some shops at this corner.

The lighting of the subway is from 14 ornamental lamp posts surmounting the concrete balustrades the entire length of subway and 18 high power lamps placed under the bridge above the roadway and the high level sidewalks.

The excavations in the subway totalled 25,000 cubic yards of earth and 12,000 cubic yards of rock. The concrete work amounted to 4,000 cubic yards, while there are 8,000 square yards of scoria block paving.

The machinery used was chiefly driven by electric power and gasoline, only the steam shovels being run by steam. The contract was executed within the specified time, 16 months, and the work was done without a cent extra on the contract price of $176,176, and without any alteration of the original plans.

It was a condition of the contract that there should be no interruption of C. P. R. traffic. It was therefore necessary to build the subway and bridge in two sections; first the south half of the excavation was done, the retaining walls constructed, and the steel put up, thus enabling the C. P. R. to use during the work three lines of track. When this was completed, the railway company laid their rails on it, and the work on the north part of the contract was commenced. The top of the bridge is covered with waterproofing material and broken stone ballast. On account of surrounding property, special precautions had to be taken to prevent damage by blasting the rock, which was Montreal gray limestone. When the rock had been blasted, it was removed by steam shovels. The C. P. R. have now laid seven lines of track on the bridge, in place of six. The steel in the bridge work was supplied by the Dominion Bridge Company.

Will Use Wood Blocks

The committee on streets of the Seattle Municipal League, after five months of investigation of the merits of various forms of pavements now in common use and the manner in which these pavements have stood up under actual wear, has recommended that creosoted wood blocks be used for the improvement of the East Marginal Way, a big street improvement project which is being worked out for the future development of the city.

Motor Trucks for Deliveries

Dealers who use auto trucks extensively for deliveries are noticeably those who have the reputation of being good business men. The auto truck materially widens the circle of economical service from any given yard and in this way is a business builder.

North end view, Park Avenue Subway, Montreal, P.Q.

Fulford Home for Aged Women, Brockville—Hugh G. Jones Architect.

Fulford Home, Brockville

We reproduce herewith an illustration of the Fulford Home for Aged Women, now under construction at Brockville, Ontario, from designs prepared by Mr. Hugh G. Jones, architect, of Montreal.

The cost of this work, amounting to about $80,000, is being provided out of a bequest to the Brockville General Hospital by the late Senator Fulford. The extreme dimensions of the building are two hundred feet frontage on King Street and one hundred feet on First Avenue. The general design of the building is along the lines of the early Tudor Farm or Manor houses. The building contains 42 bedrooms, dining room with seating capacity of 50, library, two storey living room, diet kitchen, hospital, matron's and nurses' rooms, kitchen, staff dining room and laundry, two enclosed porches and one sun room. Provision is also made for future extension.

The exterior is being constructed of McArthur brick laid with wide joints, slate roof and stone trimmings. The floors, stairways, and all principal partitions, are hollow tile and concrete fireproof construction—exterior walls terra cotta blocks brick-faced. Floors generally are of concrete; battleship linoleum is to be laid directly on the concrete in bedrooms, dining, and living rooms. The trim is in fumed oak, except in the bedrooms and toilets, where it is pine, white enamelled. The toilets have ceramic mosaic floors and cove, and Keene's cement enamelled walls, including bath and toilet partitions.

The contract for carpentry and masonry has been let to Mr. A. Cameron, of Alexandria, Ont.; roofing and sheet metal to McFarlane Douglas, Montreal; plastering to McNulty Bros., Montreal; tile and mosaic work to the Robert Mitchell Co., Ltd., Montreal; electrical work to A. G. Dobbie, of Brockville; heating and plumbing to Geo. Ross & Co., of Brockville. Linoleum floors are to be supplied by Murray-Kay, Limited, Toronto.

Sudbury Business Block

Work on the Stafford business block, corner of Durham and Larch streets, Sudbury, is making good progress. The block will be three storeys and basement high, of steel construction with pressed brick facing. The brick of the building will be finished with a raked joint, the first building in Sudbury to employ such a joint. The block will be used for stores and offices, the ground floor and the basement as a store and the upper two floors for offices. The store will have a metal front of plate glass show windows. Heating and ventilation will be by Spencer boiler and Kriebel Baker vacuum system. The block is being built for F. M. Stafford by the Le Barge Lumber Company at a cost of $50,000. Ellis & Ellis, Toronto, are the architects.

The Stafford Business Block, Sudbury—Ellis & Ellis, Architects.

The History of Pneumatic Caissons

A Story of the Development and Description of the Methods Adopted at Various Points on this Continent

By E. G. Matheson*

IN 1852 Dr. Potts' Vacuum Method was tried to sink a six-foot cylinder through 25 feet of sand in North Carolina, at the Pedee River. Then they tried the Plenum Pneumatic Method by pumping in air—the introduction of this method in America.

The second application of the latter method in America was at the Third Avenue bridge over Harlem River, New York, about 1860, followed by the St. Louis Eads bridge and the Omaha bridge by Sooysmith about the same time (1868); then the Brooklyn bridge in 1870.

The largest undivided working chamber was the Hartford stone arch bridge, 131 x 46 feet. It was a timber caisson with a deck four feet thick.

The first building to be erected on a pneumatic caisson was the Manhattan Life building, 66 Broadway, New York, in 1893.

Foundations—History of Development

The Pneumatic Caisson Method for the construction of foundations is used to overcome the influence of hydrostatic head on an unstable or quick soil, or where an abundance of water cannot be combatted in any more economical manner. The method has its limitations. It is seldom employed for depths under 30 feet, owing to its high cost, but for this depth and even less conditions are sometimes met which make it a necessity. On the other hand, when the hydrostatic head to be overcome requires an air pressure of over 50 lbs., its employment involves too much risk to the lives of the laborers to justify its use. Also, the cost of the work, at this depth, is very great, as two shifts of about forty-five minutes each constitute a day's work. Between these depths, however, (30 to 115 feet), the method is perhaps the most satisfactory now in use, affording, as it does, a careful inspection of the foundation beds; and in consequence the area of pier may be so reduced, if conditions warrant it, as to materially lessen the cost, or the area may be enlarged if nature of underlying material so demands. Like most branches of engineering, caisson work has been a growth. The originators of many ideas now accepted as best practice are entirely unknown, while again, other ideas of much less value have been granted patents the infringements of which have been and will be the cause of much litigation.

The power of air, or other gas, to exclude water from an inverted vessel was early known. During the first decade of the 16th century two Greeks at Toledo, for the amusement of Charles V., entered an inverted chaldron with a light, were submerged, and when brought to the surface the light was still burning and their garments still dry, to the astonishment of all beholders. Early in the 18th century Dr. Halley, of the Royal Society, described the use of the diving bell, and under his direction air (Pabulum Vitae) was first delivered to those within to sustain them for long intervals. The possibility of doing work under water was suggested by Halley. It was not, however, until 1778, while Smeaton was repairing the shoeing of a bridge at Hexham, that the bell was actually used on construction work. In this case the top of the bell was above the surface. Subsequently to this, at Ramsgate, Smeaton forced air through a hose to the diving bell, which was used to remove stones in clearing the site of a pier foundation.

The next advance was made by Sir John Rennie in 1813, while engineer for Ramsgate Harbor. This was a cast iron chamber, with glass bullseyes, or windows, in the top. Chains were attached to the underside of the top in order to carry heavy weights, and seats for the workmen were provided. The whole machine was raised or lowered in the correct position by tackle suitably located. The bell was moved by those at the surface on certain signals from those below, given by strokes of a hammer on the bell.

In 1830 Thomas Cochrane took out a patent for a compressed air shaft, but the first application of the air shaft, or caisson, was made about 1839, by M. Triger, on the River Seine at Loire. About this time he also employed it in a coal mine near Chalons. Since that time the development of this method has been some modification of the air shaft idea, retaining the working chamber at the bottom more or less air-tight, with its cutting edge walls and its deck, through which pass the pipes for transmitting light, signals and air, and sometimes for discharging the materials excavated, and also one or more shafts for the passage of men, earth and tools. Above the deck the caisson shaft (or pier), was continued by a cofferdam, which may or may not be filled with masonry, or only partly filled. This masonry may be so firm by the time of sinking the cofferdam that forms from the deck upward may have been removed to be used elsewhere. This is to-day the usual practice. Each of these several parts should be discussed separately and in order.

The Cutting Edge

First, the Cutting Edge—This at one time was supposed to do what its name implies, and was made occasionally of cast iron, but usually of a more or less elaborate combination of steel shapes, as plates, angles and channels running as high as 200 per lineal foot. This method has been largely discarded as a useless expense. Of course, conditions have justified, and will continue to justify (in particular cases) such cutting edges, as when a caisson of considerable weight must be located or set on a river bottom in deep water. It may happen that some irregularity of the bottom may set up very great stresses in caisson. In such cases too much attention cannot be given to preventing any distortion or rupture of the parts of the working chamber. Where, however, it is possible to keep the cutting edge under the direct attention of the "sand hogs" or workmen, no elaborate cutting edge is necessary.

The writer has in mind one case where a long and well supported cutting edge was a decided advantage. Six caissons, each about 18 feet long and 5 feet wide, were sunk through buried crib work. There was only

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enough black mud to render the water non-transparent. The remainder of the material consisted of rock and round timber, which was always under water. The rock had to be removed by the use of bars, and the timber had to be cut by means of wood chisels and hammers, in such a way that the caisson could pass freely between timber left on either side. The long V-shaped cutting edge was here an almost indispensible requisite. Ordinarily, however, an angle on the outer bottom edge of the timber side wall of the working chamber, or a channel on the bottom, is all that is required. In fact, if the caisson should continue to slide gently down, as it usually does at first, no special protection is needed, but, as the depth increases the motion of the caisson usually consists of short, sudden drops, which is quite likely to deform a cutting edge of wood only, particularly on the outer edge, which will soon cause the bottom of the sides to move inward and the caisson to assume the form of a blunt wedge, making sinking very difficult. If the side walls are of wood perhaps the best protection would be a channel with the flanges upward and bolted to the timbers. If the working chamber is of concrete entirely, an angle with bolts concreted in and the walls reinforced is very satisfactory.

Side Walls

The Side Walls.—These have been made of steel, wood and reinforced concrete. The condition existing at the site, or the purpose of the work, may dictate the material to be used. Where the outer form constitutes the lining of a large shaft, requiring much clearance, steel plate with internal strengthening angles makes a very desirable form of structure, although wood and concrete may serve fairly well. Perhaps wood is the most serviceable where cheapness and speed, as well as adaptability (an important point) are desirable. These walls should be of a strength—whatever the material used—sufficient to withstand the earth pressure, together with the necessary stresses developed by the methods adopted in sinking. There are those who urge that if the outside faces of the walls are battered the frictional resistance to sinking will be greatly reduced. This is not always so, as stones and gravel loosen, roll against the walls, and exercise a binding or gripping effect which often offers more resistance than the ordinary friction, and by concentrating pressure may rupture the side walls, which (when of wood) have a cross section of from 6 x 6 in. to 12 x 12 in. It is also a fact that a caisson with battered side walls is most difficult to keep plumb, or what is the same thing, to keep in the same position.

There is another effect which makes such a caisson more objectionable. Its use results in an undue subsidence of the adjacent earth, thus endangering street surfaces, water and gas mains, as well as the nearby buildings, which are not on rock or hard pan. The walls are usually plumb; the earth or side pressures vary greatly. In very stiff earth with a steep angle of repose, through which rapid progress may be made, little pressure is developed; on the other hand, through ground which offers much resistance to fast sinking and which slides easily, as a wet clay, with boulders, very great pressure may develop, and in addition boulders may roll against the sides of the chambers and cause great damage through excessive pressure. It is very desirable also to have as few braces or bulkheads in the working chambers as possible, as these offer obstruction to rapid work in handling the earth. Therefore, every effort should be made to devise some mode of strengthening the side walls which will give a maximum of strength with a minimum of material used, as well as of obstruction of working space.

The Roof

The Roof.—Here again, various materials have been employed. At one time steel decks for working chambers were used, but in America these soon gave place to wood or a combination of wood and steel. With wood or this combination the work could be begun with much less delay, there being no need to await the seasoning of the masonry, as the wood and steel take all the stresses. The steel walls and deck are not so much used in America, where wood is cheap, and abundant, as in Europe. The deck at one time consisted of a great thickness of squared and dressed timbers, strongly drift-bolted together, alternate layers crossing one another, the under side sheathed with three-inch dressed plank with a caulking groove. The whole inside of the working chamber is usually caulked and tarred to make it practically air-tight. In the case of the Manhattan caisson for the Brooklyn bridge (sunk 1871, 102 ft. x 170 ft.) this deck was 22 ft. thick. This caisson had the underside of the deck sheathed with wrought iron plates to prevent danger or fire, due to the manner of lighting (torches). Soon, however, the thickness of wooden decks was greatly reduced by the use of bulkheads in the working chambers and knee braces underneath, as well as sometimes tying the deck to the cross bracing of the cofferdam above. Since the advent of reinforced concrete an effort has been made to have a well-seasoned portion of this material above the wood, which not only makes a much stronger and more rigid caisson, but also renders it more air-tight, and, moreover, supplies weight—a much needed commodity in such work.

Caisson Deck for Quebec Bridge

It is interesting to compare the thickness of the Brooklyn Bridge caisson deck with that of the Quebec Bridge, 180 ft. x 55 ft., as illustrating recent practice. The latter consisted of two courses of heavy timbers, one longitudinal and one transverse. These were separated by two courses of 3 in. tongue and grooved planks crossed diagonally. Through this deck are placed the following pipes: One small pipe carrying the wires for electric lighting. This pipe is sealed at each end, but has a valve at the bottom end within the working chamber and above the bottom seal. At the top end, beneath the top seal, there is an opening which, when the valve below is opened, emits a loud whistle. This is the means used by those within to signal those without. The return signal is usually given by blows of a hammer on the air-lock. There is also at least one three-inch air pipe (sometimes two) connected by a flexible hose with the air supply, at some point where there is little danger of breaking this supply pipe. When there are not two pipes down through the pier to the working chamber, a second air connection is made to the steel shaft just below the air-lock.

This latter method gives equal safety and equal convenience when the shaft has to be lengthened as the pier is sunk. A pressure gauge and a valve are placed beside each other on the supply lines; these are attended constantly by a gauge tender, whose duty is to regulate the pressure required. The number and size of these connections depend on the size of the caissons and whether the air is or is not to be used to assist in the excavation.

The shaft serves two purposes: First, to take in material and supplies and remove the excavations;

second, to serve as a passageway to the "sand hogs." Small caissons have only one shaft, which serves both purposes; larger caissons have two or more shafts, but unless watched, the workmen use the shafts indiscriminately. As a rule the men in the smaller caissons enter and come out by using the muck bucket. Every shaft for men must have a satisfactory ladder from top to bottom of shaft for emergency and in case of action for damages. It is, however, very seldom—and very reluctantly—that a "sand hog" uses this ladder. At one time the shaft, which is of steel or cast iron, extended from the deck—to which it was securely belted—continuously through the pier to the surface. The shaft varied in size from 3 feet in diameter to a much greater diameter. The lock may occupy any portion of this shaft, as best suits the circumstances. The best practice to-day places the lock at the top of this shaft. This allows the lock tender to remain in the open air. In case of accident to the air supply it allows the "sand hogs" an opportunity to save themselves from drowning, by climbing up the shaft to such a point as to be usually above the water level, or to such a height that the entrapped air, by being compressed by the rising water, may finally counterbalance the hydraulic head.

This metal shafting is so made that it can be collapsed and removed from the piers unless the bottom happened to be caught by the concrete used in sealing the shaft. At one time a short length of metal shaft was always lost. This was later replaced by a wooden form, and to-day the shaft is moulded in the middle of the pier by the use of collapsible wooden forms; the only metal shaft used is at the top and is only long enough to securely attach the lock to the sufficiently seasoned concrete. The shaft may be circular or oval in shape. A narrow vertical strip with parallel faces for joints can be pulled into the shaft, and then the whole shaft may be collapsed and removed. The shafts are in segments, with internal flanges, which are bolted together. The gaskets for the vertical joints are usually ¾-inch hollow rubber tubing, while the gaskets for the circular joints are made of cotton—called lamp wicking by the "sand hogs."

The Lock

The lock may be a portion of the shaft with two doors, both opening toward the working chambers, with by-pass valves, so that the space between may be placed under atmospheric pressure when the outer door may be opened: or under same pressure as the working chamber when the inner door may be opened. The lock is usually somewhat larger than the shaft except when a metal cylinder is being sunk under conditions which demand such a special form, as in underpinning work, when the working space is limited both as to area and head room. The cylinder, which is later to be filled with concrete, may consist of cast iron sections about 5 ft. long by 3 ft. in diameter; the bottom section is the working chamber and the second one is the lock. The cylinder is forced down by jacking against the building, or some other sufficient resistance.

In some large caissons an effort has been made to have a very high working chamber and a very long lock, so as to introduce into the working chamber long timbers to be driven as piles. This method has not had a wide application. It is, I believe, patented by W. H. Patton. The most satisfactory place for the lock is at the top of the shaft and well above the water level, where the lock tender is not under pressure and the clear shaft offers a place of safety for men in case of accident. Locks are usually circular or oval in cross-section, about 5 feet in diameter and from 6 to 7 feet in length; the bottom door leads into the shaft, and the top door may be in the top end or may be in the side.

There have been many styles of doors and locks of more or less efficiency, but the Moran and O'Rourke designs are perhaps as satisfactory as any. The Moran lock requires two attendants, while the O'Rourke lock requires only one. Both are controlled by patents, as are most of the locks possessing any real advantages. The doors are opened by levers on the outside. The connections of the levers to the doors within are made by stuffing-boxes through the skin of the lock. In the majority of locks the derrick cable—handling the material and excavation—goes through the top door of the lock, the hole fitting the cable as closely as possible without doing it any injury. The amount of air escaping is inconsiderable. In the case of the O'Rourke lock there is a stuffing-box on the cable through which the cable moves freely. When the bucket is down the shaft the stuffing-bucket fits in a circular hole in the top door; when the bucket is not down, and the bottom door is open, the hole in the top door is closed by a dummy stuffing-box. The bivalve doors of the O'Rourke lock form a portion of a sphere. All doors in air-locks are fitted with rubber gaskets, ½ in. x 3 in. to 4 in., against which the doors are pressed by the high air pressure inside.

There is one danger which the top doors present which must be carefully guarded against, particularly when the pressure is low—a weight falling upon it may force it open, allowing the caisson to flood. An accident of this kind occurred on a bridge caisson near Jersey City; an empty bucket was dropped and forced open the door. The lock-tender lost his head for a fatal moment and did not close the door again until too late. All the gang below were drowned. If, when a high pressure is in the chamber, the air supply is lost, the working chamber and the shaft very readily fill with sand or clay; and, as a consequence, when once the air excavation has been begun in a caisson the air pressure must be continued till the chamber is filled with concrete.

Cofferdam or Outer Form for Masonry

Here again wood has largely replaced metal; and when a rush job is demanded this outer form is left on, the space between the cofferdam and the shaft being filled as high as need be, or as can be done by concrete, but as this may not be very well seasoned, the cofferdam carries most of the weight used to force down the pier, which sometimes is more than the ultimate load on the pier when the structure is complete. Some prefer to leave the forms on the concrete, as the wood causes less surface friction than the masonry. In all cases the surface should be well coated on the outside with some heavy lubricant. The masonry is built as high as is compatible with safety (say 30 ft.) or as high as the booms will reach before sinking.

If the caisson can be carried to final depth without stopping to lengthen the shaft, and perhaps to place more masonry—an operation requiring tons of weights to be taken off and then replaced—a great saving can be effected. It is, however, rather risky to build small or moderately-sized piers high and then begin to dig the earth from beneath. The pier must be supported on all sides by substantial raker braces, and the excavation must be done very carefully in order to maintain the pier vertical. If the job is not to be completed in an unusually short time the forms are made so that they may be used as frequently as possible.

Economy has demanded that the working chamber, as all other parts, be made as light and cheap as possible. The working chamber walls are now seldom over five feet high; indeed, they are often less, head room being obtained by keeping the excavation well in advance of the cutting edge, or the deck is arched, or both may be done. Tongued and grooved timber, caulked and tarred, is expensive work, so an effort has been made to use light, collapsible wooden or (sometimes) steel forms, which may be removed from the shaft and used again, so that there will be nothing in the pier but steel and concrete. This is a doubtful economy in many cases, particularly when the caisson is large and heavy loads come on the soil, which may cause settlement before the concrete is seasoned, thus endangering the pier. The writer had to design forms for the working chamber for five piers which were each 40 feet square and 2,000 tons in weight. The only part of the pier resting on the soil was the cutting edge, which was 6 inches wide. The supports for the roof forms required to be so designed that the settlement had to be uniform throughout to avoid cracking of the pier. The working chamber had one bulkhead. A hole was left in the bulkhead wall, and also in the working chamber, in order to remove the timber, as it was too long to be sent up the shaft unless cut.

Sinking the Caisson

Let us suppose the working chamber is carefully set in position and built as high as practicable, and has had time to sufficiently set to commence safely the work of sinking. The outside is well greased. One or more frames, about one foot larger than the caissons, are set around it on posts and are strongly braced by raking shores. Properly shaped wedges are placed between the frames and the sides of the caissons. Plumb bobs are suspended to two adjacent faces of the caisson. A man is placed to watch these while men are sent inside to excavate the caisson down as far as possible without air (called "ditching") usually a little below water level. During this preliminary sinking the caisson is brought to the vertical by means of the wedges and braces. Then by means of a level marks are made on the inside of the working chamber so that the "sand hog" may know at all times how the pier stands, and may govern the excavation accordingly. Next, the air connections are made, the light cables are properly connected up, the shaft is put on, and finally the lock, and the air men commence operations. At first the caisson moves down gently, as the earth is excavated; and as the depth increases more weight is needed. This is supplied by piling on cast iron, now in blocks about two and one-half tons in weight, handled by a derrick. At one time in my experience a gang of from fifteen to twenty men were employed continually piling pig iron on top of the caisson. After a time the friction becomes so great that the caisson moves in sudden quick drops of varying dimensions. Here is where the cutting edge or the sides may be injured.

Sometimes, when no more weight can be placed on top and the pier is not to the proper depth, recourse is had to what is called "blowing the caisson." First, the man at the gauge is ordered to open his valve to raise the air by four or five pounds. This causes a flow of air up the outside of the caisson, lessening the frictional resistance. Then, simultaneously, the air supply is cut off and a valve is opened to exhaust the air in the working chamber. The "sand hogs" may, if deemed safe, remain in the chamber, climb the shaft, or come out. When the caisson begins to move the exhaust is shut and the supply opened to prevent flooding of the work chamber.

Proposed Union Station and Tunnel, Montreal

At a luncheon held at Cooper's Restaurant, attended by members of the Montreal Builders' Exchange, on June 7, Mr. F. N. Armstrong explained in detail the proposed central terminal station and tunnel under the St. Lawrence, to be built by the Montreal Central Terminal Company. He pointed out that although Montreal traffic had enormously increased, the railway companies had done nothing in the way of improving their terminal facilities, with the exception of the C.P.R. The proposed line would do away with grade crossings; it was imperative the Grand Trunk crossings should be removed, but the company would not be able to raise the requisite money for some years. The Central Terminal Company was incorporated in 1890 for the purpose of constructing a bridge; their plans were then changed to a tunnel to be used for electrically driven trains. Still later, the present scheme was decided on. Just before the war broke out, Mr. Armstrong had interested English capital in the project, but the conflict put an end to this. He had then visited the United States and had succeeded in obtaining the promise of capital provided that the different railway companies would enter into agreements to use the proposed terminal station. All the companies were favorable, except the C.P.R. and Grand Trunk, who raised various objections.

The station would be built on Lagauchetiere and Vitre Streets, in the centre of Montreal, with the main entrances on those streets. Mr. Armstrong then explained how it was proposed to link up the various lines by means of a short line to be built by the company, giving everyone access to the Union Station. There would, he said be a freight station in the east end of the city, and sorting yards would be constructed. The C.N.R. had under consideration the building of a large station in the city in connection with the Mount Royal tunnel; this would be abandoned and the C.N.R. given access to the Union Station. The Place Viger Station of the C.P.R. would be used only for feight traffic, and the present line of the Grand Trunk as far as St. Henry would be given over to freight, that company coming into the city over the new line of the Terminal Company. Six tracks would be built on this line, while the tunnel would be double-tracked. The entire line would be electrically operated.

The construction of the station would involve the rebuilding of two main and several side streets. The Terminal Company would charge the different companies a rate basis on the extent to which the lines and station were used, but only sufficient to pay certain capital charges and the interest on the capital.

The Union Station would save an immense amount in cartage, would be a great convenience to the general public, would supply a suburban service at a low rate, and give better communication to the south side of the St. Lawrence.

The Montreal Light, Heat and Power Company have issued a new house organ under the title of "Our Magazine."

The Granite Paving Block Industry

A Description of Its Development in Canada—A Bright Future.

By James S. Wilson*

The granite paving sett industry occupies an important position in every country, but perhaps more especially so in Britain, on the Continent of Europe, and in the United States. The European engineer has cautiously, yet amply, experimented with other classes of paving, but during the last ten years or so his experience and energies have been more particularly directed towards improving the granite block. As Canada is a new country, so far as paving is concerned, it may be best in dealing with this subject to compare conditions here with those obtaining in the older countries, analysing their excellent data so that some logical conclusion may be arrived at regarding the merits of this paving and the prospects of the industry here in the future.

During the period of the Roman occupation of Britain, paved roads were constructed for military purposes. Granite rubble was used, consisting of irregular-shaped stones with a level head, the whole being skilfully laid and grouted with a mixture of fine marly clay. In several places, evidence of their handiwork on a fairly extensive scale, and still in an almost perfect state of repair, can be seen. This was possibly the origin of stone paving.

Some two or three centuries ago the manufacturing of granite rubble paving was started in Aberdeen and shipped to the London market. Since that time the Aberdeen granite has practically monopolized this market. The rubble paving was similar to that employed by the Romans on their famous military roads. From this crude beginning has sprung up, by gradual process, the almost perfect Nidger Block paving. The original rubble gave place to the common sett which was from 5 in. to 7 in. on the head and from 9 in. to 15 in. deep, the ordinary sett (called the Belgian Block in the United States), displacing the common sett some sixty or seventy years ago.

Paving Stone of the Future

The most modern form of smooth granite paving consists of blocks from 5 in. to 6 in. on the head and varying in depth from 5 in. to 7 in., with lengths restricted generally to about 12 in., the head joints and sides being nidged or bushed, affording a smooth and perfectly level surface, and permitting of close jointing. During the last few years, the large cities across the water and in the United States have been laying these blocks extensively. While the cost of this class of stone is greater than the ordinary sett, it has not been adopted without undergoing severe tests, and no doubt this will be the paving stone of the future.

In the cities and larger towns of Europe and the United States, granite paving is used extensively because it has been found from experience to be the only paving capable of withstanding the heavy traffic existing in industrial centres. The granite is more widely diffused there, towns are closer together and markets more accessible. The cost of repairing a street, say, in London, Liverpool, Glasgow, New York, or Chicago, is found, from sad experience, to be generally greater than the original cost yard for yard; hence it follows that a paving requiring a minor expenditure in maintenance, even at a greater first cost, is, by far the cheaper in the end. The life of granite is much longer than any other form of paving, which altogether demonstrates the superiority of this material for most purposes.

In Canada, opposite conditions are met with. The granite is principally found in the extreme east and the west. Markets are far away, in consequence of which the cost of granite over the other classes of paving is slightly greater than across the water or in the United States. Does this condition warrant the use of granite in preference to other paving, even having regard to the longer life, lower cost of maintenance, cleanliness, better foothold for horses, etc.? Public paving work in the older countries is generally constructed with funds provided from revenue, here principally by borrowing. As a rule, the life of most forms of paving has been extinguished before the amount borrowed for the work has been paid back. This does not seem sound, as, in effect, it is imposing a debt on the future taxpayer without transferring to him any corresponding advantage; while in the case of a long-lived utility at a not excessive first-cost, with a low annual maintenance expenditure, it is the reverse, the debt being liquidated long before its period of usefulness has expired.

Granite Setts and the Present War

The resources and energies of the military officials on the continent have been taxed to the utmost with enormous transportation difficulties. Excellent as were the continental roads, they were found to be incapable of withstanding the abnormal wear and tear imposed upon them in the huge task of transporting supplies for the armies. The matter was one of vital importance, some expedient had to be devised to meet the critical situation. There could be no question as to what was best. What the British Government official does, he does well; the best had to be provided, and the best was granite blocks. Towns and villages lying on the lines of communication have been or are now being paved with this material.

There can be no doubt of the results or the wisdom and foresight of our famous corps of engineers in their selection, for although other classes of paving could have been executed quicker and cheaper, the well-tested qualities of granite leave no room for questioning the part this paving will play in the ultimate issue of the war.

Although the granites of Canada do not, on the whole, equal in quality the granites of Europe or the United States, there can be no doubt of the existence in this country of fields of splendid granite awaiting development.

The European method of block-making is different to that employed in Canada and the United States. Granite formations there are generally massive, that is, irregularly bedded and jointed, while on the American Continent it is principally sheet formation. This is to our advantage, as the cost of quarrying and working the latter is less than that of the former. Again, blocks are made there, practically in every case, without the aid of power tools, the cutting of the larger pieces being accomplished with either wedges or plug and feathers, the holes being drilled by hand. The mall, or buster, is then used to reduce the block to a

* Sirdar Granite Co., Calgary.

smaller size, the splitting of the block being done with the mall and mash hammer, the latter being again used to nick and knap the mashin (a block from which several paving blocks are obtained) and roughly shape the sett, which is finally finished by a hand hammer, the reel, tiller, or side hammer.

This system applied here would be decidedly unprofitable and wasteful, as it produces a large amount of rough material only suitable for crushing for road macadam and granolithic work; as there is a great demand for these products there, it is a source of profit. Otherwise the stone for crushing would have to be lugged or broken to a suitable size for the cruhsing machine.

Avoid Creation of Useless Stone

In Canada, where we have, so far, little or no market for crushed material, the creation of useless stone must be guarded against and the expense of disposing of same avoided. This is where the more shapely sheet formation is of advantage. The same may be said to hold good in the case of columnal formations in trap rocks, basalts, etc.

The stone supplied to the Canadian cutter is more regular in shape. In addition to the ordinary kit of tools he is supplied with a power drill. Instead of resorting to the uncertain method of splitting with the mall, he makes use of this tool to put in the holes, the more reliable plug and feather being used for cutting. Again, in blocking (knapping), the stone is marked with a tracer which ensures the creation of a block with a good head and arrises on, which requires considerably less finishing than the block turned out by the European sett-maker. The waste stone is reduced to a minimum, quarrying and on-cost charges are lowered, and less plant required. Taking all the circumstances into account, our methods are superior to those practised across the Atlantic, and sufficiently so to offset the higher scale of wages, fuel, etc.

The manufacturing of granite blocks in Canada has been greatly hampered in the past by the lack of experience on the part of the quarry-owner, shortage of skilled labor, and the difficulty of transportation to markets; the latter factor will be rendered easier, of course, as time goes on and the country opens up.

Man has no more difficult problem to face than to profitably win from Nature her resources. To achieve this result, the quarry-master must be a student of Nature, well versed in the handling of stone and possessing a thorough, practical knowledge of the trade.

There are many grades of granite and, while two stones may be composed of practically the same mineral constituents, the qualities of the stone for commercial purposes may vary in the extreme. Even to a skilled and experienced quarry-owner, the selection of a suitable stone presents difficulties. There is no better way to determine the qualities of a granite than by the application of the tools and to do so, one must be able to use them in a workmanlike manner and be able personally to feel, as it is termed, "the way o't."

A disadvantage quarry-owners in the United States and Canada have to contend with is the attitude of municipal authorities calling for tenders for granite for quick delivery, the time allowed for delivery in many cases being less than the time required to manufacture the material. These stones are all made by hand, skilled labor cannot be secured at a moment's notice, the quarry-owner cannot guarantee delivery in time, with the result that all too often the work is executed with other material. There is no need for this state of affairs. In Europe, municipal authorities estimate their yearly requirements at the beginning of the year, when tenders are called for and accepted, and though the material may not be required till much later, it enables the quarry-master to make his plans, and, if he desires, to make and stock the blocks. This ensures a regular supply of labor, keeps the quarry working, and obviates the lack of regular employment which is such a drawback to this country. It further enables the consumer to buy cheaper, to secure better dressed material and assures the timely carrying out of the predetermined paving plans. The dressing of the blocks is of the greatest importance and careful quarry inspection must be made. The rush order is the greatest incentive to bad dressing, and as these orders generally arise from lack of foresight on the part of the municipal authorities, so must the bad dressing be attributed to them. It is the duty of every quarry-master to insist on the production of a first-class block. A good head with well defined arris, full jointed, good bottom and regularity in size should be aimed at. Practical experience has demonstrated the fact that paving cutters will turn out as many blocks when they are compelled to adhere to the specification as when they are allowed more latitude in the dressing. As time goes on, the requirements in this direction are becoming stricter, but while those strictures may seem to hamper the industry for a little, the beneficial and lasting effects to it will become strikingly apparent. Such is the experience in Europe.

Having established from the experience of the older countries the great importance attached to granite block paving, taking into consideration the problem of an ever increasing traffic, with its consequent tear and wear, and the necessity for permanence and durability of construction in our channels of transportation, it seems reasonable to predict a bright future for the granite block industry in Canada.

Longest Life of Any Pavement

With practical quarry-owners, a plentiful supply of skilled labor, a judicious use of power tools and good stone, the cost of production should compare favorably with that of any other country. Being in a position to compete with cheaper and less durable pavings, new markets will be created; smaller towns, which have not hitherto been able to avail themselves of this advantageous form of paving will be enabled to do so; transportation facilities will be increased and taxes reduced. These are very often the determining factors in the choice of a site by industrial concerns, so that the community benefits in general. It is a fact the world over, with few exceptions, that the greater the industrial centre, the greater the use of granite block paving, or inversely, the industrial importance of a town may be determined by the amount of granite paving it has. Granite block has the longest life of any paving; it can be lifted, redressed, and relaid at small cost and made to serve for a second period. Looked at from any aspect, the use of granite block paving will be found to be consistent with sound municipal financing, and, instead of burdening our future citizens with debt, an asset will be created for them. The cheery appearance of the material will beautify and enhance the surroundings, healthier conditions will be obtained, which, in effect, will earn in some measure the appreciation of that human enigma —the taxpayer.

Trade Publication

Exciter Sets—The Terry Steam Turbine Co., Hartford, Conn., are distributing a booklet describing and illustrating their duplex exciter sets and enumerating the advantages which are claimed for them.

Grease and Fertilizer from Sewage

A More Economical Method of Sewage Treatment — By-Products Exceedingly Valuable

EXPERIMENTS to determine the feasibility of a new process of sewage treatment invented and patented by George W. Miles, a Boston chemist, were made from 1911 to 1914 under the direction of E. S. Dorr, of the Boston Sewer Department, with results that seem to indicate that it will be not only successful, but profitable. The process is described by Mr. R. S. Weston in a recent article in the Journal of the American Public Health Association, from which we print the following extracts:—

Ordinary sewage sludge from settling basins is greasy, offensive and of so little practical value that farmers will not accept it for fertilizer, even as a gift, yet sewage sludge contains fertilizing elements of great value and considerable grease. The Miles process attempts by the addition of an acid to precipitate the bulk of the solids from sewage in the form of a sludge that can be dried and degreased, thereby producing a readily saleable and greaseless fertilizer, as well as recovering the valuable grease. Either sulphuric acid or sulphurous acid may be used, and the process contemplates the manufacture of the acid at the disposal works. If sulphuric acid were chosen, ordinary weak chamber acid of 1.53 specific gravity would be used, but the cheapest source of acid is undoubtedly pyrite (native FeS_2), which when roasted in a furnace of proper construction produces sulphur dioxide (SO_2). This is a gas that may be fed directly into the sewage, in which it would dissolve, forming sulphurous acid.

The addition of sulphur dioxide precipitates most of the grease, together with the greater part of the suspended matter. The resulting sludge is dried, extracted with a solvent to recover the grease, and the remainder prepared for fertilizer. An important sanitary feature of the treatment is that the sulphur dioxide is a strong disinfectant, so that the acidified sewage contains few bacteria. It also contains but little suspended matter. Consequently, the supernatant liquid may be discharged into a body of water without producing any nuisance.

The experiments, which were conducted by officers of the sewer division of the city of Boston, consisted of 11 runs, involving the treatment of about 26,000 gallons of sewage. From these experiments it was concluded that from 1,000,000 gallons of sewage 1,738 pounds of dried sludge would be obtained and that it would contain 21.7 per cent. of grease, which at 4c. a pound would yield $15.08. In addition, there would be 13.61 pounds of fertilizer base, estimated according to agricultural standards to be worth $9.25, making the total value of the recoverable material about $24.33 per 1,000,000 gallons.

The results of Mr. Dorr's experiments were so promising that their repetition under the supervision of impartial investigators and for a longer period was thought worth while, and arrangements were made for a week's study of the process under the supervision of the sanitary-research laboratory of the Massachusetts Institute of Technology. These further experiments were begun on July 7, 1915, and were made under the direction of Robert Spurr Weston, with Prof. W. T. Sedgwick in consultation. The results obtained were checked by further experiments, covering three days, which began on November 8, 1915, so that the tests covered both warm and cold-weather conditions. The close agreement between the results of the two sets of experiments is remarkable, and it may be definitely stated that the experiments of the sanitary-research laboratory confirm the results obtained by Mr. Dorr regarding the amount of sludge that may be recovered from Boston sewage and the amount of grease that is present therein. The Miles acid process has thus been shown to possess many advantages as a method of sewage disposal for cities like Boston, namely:

Has Many Advantages

1. It disinfects the sewage by reducing the numbers of bacteria from millions to hundreds per cubic centimeter.

2. If the drying of the sludge and the extraction of the grease can be accomplished economically, it is probable that a large part, if not all, of the cost of the acid treatment may be met by the sale of the grease and fertilizer recovered from the sewage.

3. The use of so strong a deodorizer and disinfectant as sulphur dioxide would prevent the usual nuisance of treatment works. The experiments have shown that the sludge can be held at the works for four days during the heated season without giving offensive odors, while the effluent is inoffensive and stable enough to be discharged into Boston Harbor without the slightest probability of creating a nuisance.

4. The addition of sulphur dioxide to the sewage also avoids any fly nuisance, which is a handicap to the operation of Imhoff tanks and trickling filters.

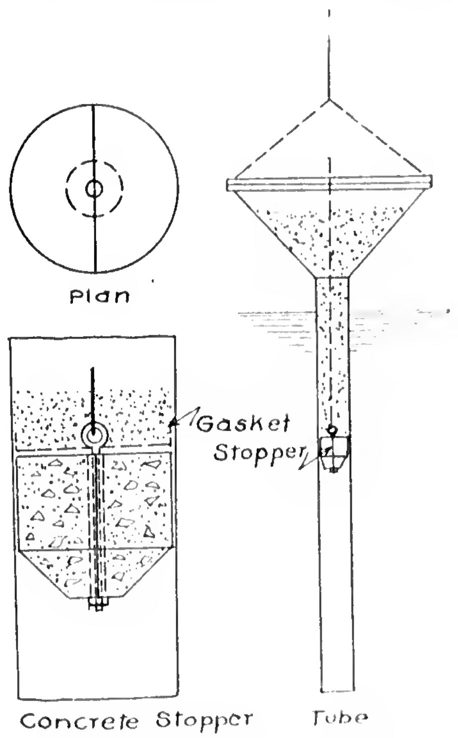
Drying of the sludge and the extraction of the grease are absolutely essential for the success of the process. Mr. Dorr's figures, which show profits of from $6 to $11 per 1,000,000 gallons, appear high, and it is possible that he has allowed too little for the acid and for the cost of drying the sludge; but even if his figures be doubled, the process is still well worthy of consideration by the city of Boston, because of its freedom from nuisance, as it produces an effluent which is practically free from disease germs and which can be discharged into the harbor with impunity.

With the facts at hand, the process would be very satisfactory for Boston from a sanitary standpoint and is more promising economically than any other known. The value of Imhoff tank sludge is hardly enough to pay for the drying. At Milwaukee, Chief Engineer Hatton estimates the total value of activated sludge at from $9 to $15 per 1,000,000 gallons, while our Boston experiments have proved that the sludge from the Miles process, although less in bulk than that from the activated-sludge process, has a value of more than $24 per 1,000,000 gallons of sewage. Correcting Mr. Dorr's estimates for the higher amounts of acid which these experiments show to be necessary, one gets $18 per 1,000,000 gallons as the average cost of treatment, and $6 as the margin of profit.

Placing Concrete Under Water

The subaqueous deposition of concrete is often a matter of extreme importance; it is also extremely difficult. The "tremie" method of deposition of concrete, so that it shall not suffer from the water, has been used to good advantage on some large and important works in recent years. Briefly, the tremie is an apparatus for depositing or consolidating concrete under water, consisting essentially of a steel or wood tube with a hopper top.

In order to secure the best results, that is, a good quality of concrete and a proper flow through the tube during operations, a considerable amount of preliminary investigation is usually necessary to determine the size of tremie and the method of handling it. Experiments seem to indicate that a 15-in. diameter tube



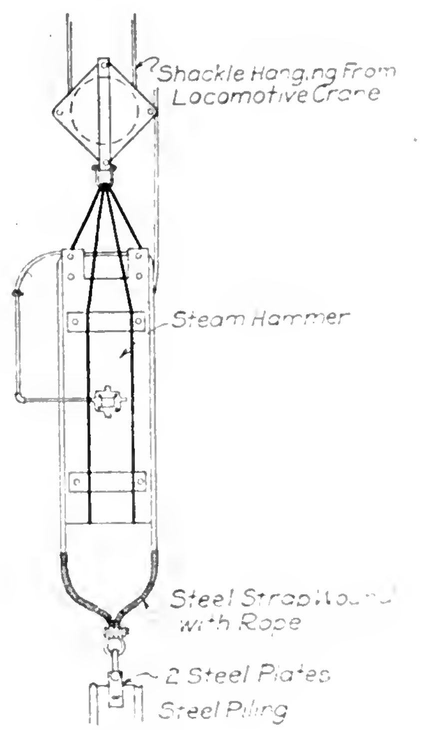
Apparatus for Placing Concrete Under Water.

gives about the best results. It gives about the right amount of friction. A 12-in. tube gives too much friction, while an 18-in. tube gives too little, often allowing a charge to be lost. There are three general points on which care should be exercised in the operation of a tremie. The first is the tendency of the concrete to choke up the tremie tube. When this occurs it causes delays and disturbs the concrete already in position. It may be overcome generally by the use of a rather wet mix with small stoning and by holding the tube high enough to start the charge moving just as the hopper starts to fill instead of after it is full. The second is with the onrush of water into the tube as the last of the charge is pouring out. The lowering of the pipe to stop the flow must be started in time so that the pipe will be completely sealed. It should be lowered gently so as not to disturb the concrete already deposited. The regulation of the speed and the proper movement for giving this signal to the hoisting engineer, are matters requiring considerable practice on the part of the men. Third, the concrete should pass through as little water as possible between the tube and the freshly deposited concrete, as otherwise a considerable portion is lost.

In depositing subaqueous concrete by a tremie the use of some sort of wadding or stopper is essential for the first filling of the tube. Various materials have been used for stoppers, such as cement sacks, shavings, paper bags and sawdust. This material is usually inserted in the top of the tube, and as the concrete is added the stopper descends the tube driving out the water until the tube is full of concrete. The difficulty, however, is that this foreign substance becomes imbedded in the deposited concrete, which is particularly objectionable if the column is at all high and of narrow cross section. To overcome this difficulty, a concrete stopper has been designed, as shown in the cut.

Pulling Sheet Steel Piling with a Steam Hammer

Pulling sheet steel piling with the hammer they were driven with in half the time required to drive them is a rather new kink in the contracting business. The hammer is inverted and fitted with a close fitting steel yoke provided at both ends with a clevice. One of these is connected with the hoisting tackle of a derrick which is kept under constant strain, and the other to the pile. The hammer weighs about 3,000



Pulling Sheet Piling with Steam Hammer.

lbs., strikes 75 blows per minute and operates either by compressed air or steam from the hoisting derrick.

Piles that take an average of three minutes to drive can, as a rule, be pulled in one and a half minutes by this method. The device has permitted the salvage of piles which might otherwise, owing to the cost of pulling, have been left in the ground.

M. Beatty & Sons, Limited, Welland, Ont., have recently been awarded contract by the Dominion Bridge Company for two 9 x 12 link motion hoisting engines with cut steel gears, and two 60 in. x 156 in. vertical boilers built under Ontario inspection, for use on the Intercolonial Railway Car Ferry Terminals at Carleton Point, P. E. I., and Cape Tormentine, N. S.

Progress on St. Maurice River Dam

GOOD progress is reported on the St. Maurice River dam being constructed for the Quebec Streams Commission by the St. Maurice Construction Company (contracts sublet to Fraser, Brace & Company). The dam site is in entirely unsettled country, 37½ miles, in an air line, north of the division point, Parent, on the National Transcontinental Railway, and 45 miles from the junction of the Manuan and St. Maurice rivers.

Designs and preliminary work have been completed for the construction of this 1,720 ft. concrete dam and the creation of the huge storage reservoir. Some 160 billion cubic feet of water will be stored, making a flow of 12,345 second feet for 150 days or 7,372 second ft. for 300 days. This storage will allow for the regulation of the flow of the St. Maurice River, so that some 168,000 h.p. more is available as steady power at three points below. The important powers benefitted are Shawinigan (82,000 h.p. at present, 164,000 h.p. future); Grand'Mere (41,000 h.p. present, 82,000 h.p. future); La Tuque (32,300 h.p. present, 78,000 h.p. future).

Largest Reservoir, etc.

This reservoir will be the largest on the American continent. The dam for the reservoir is not an unusual structure, but the project is of timely interest more from the magnitude of the flooded area than from any particular features in the construction of the dam. The preparation of plans for the dam was instructed by J. W. Thurso, with Edward Wegmann and J. M. McCarty as consulting engineers. The investigations in the field and the design were under the direction of O. Lefebvre as chief engineer.

Test borings showed solid rock underlying the site. The plain gravity type of dam was selected, with sliding gates and the profile was fixed after assuming an ice pressure of 50,000 lbs. per lineal foot, acting at the pressure level of the overflow weir; foundation uplift was neglected. The dam is to be 1,720 feet long, of four straight sections, with 851 feet of spillway. The notable features of the dam are a movable sluice for logs and rubbish, 375-foot measuring weir, and means of heating the gate chambers.

The work is of particular interest due to the fact that the dam site is situated 50 miles by route north of the National Transcontinental Railway, necessitating extensive transportation facilities. The contractors had a choice of two routes for reaching the place of work. A route from Parent was investigated and found to offer a line of easy grades and curves, but through country so badly burnt that there was not enough timber in it to provide the ties. The second route was adopted by the contractors, utilizing river transportation for 30 miles on the St. Maurice River above Manuan as far as Chaudiere Rapids, a railroad 20 miles in length being required from Chaudiere to the dam site at La Loutre.

River transportation is carried out by large scows hauled by gasoline motors. The river, throughout the 30 miles that have to be navigated, is very crooked, with a large number of sand bars. The current averages about 2½ miles per hour at ordinary stages of water. The scows are from 15 to 25 tons capacity, 10 ft. wide and from 60 to 75 ft. long. They are easily steered by a 50-foot oar in the hands of one man and guided very readily even in the crookedest parts of the river. Indian pilots who know the river are employed to steer the boats and the trip between Manuan and Chaudiere averages about five hours going up and three hours coming down. Transportation difficulties will be understood when one realizes that some 25,000 tons of material have to be transported to the dam site.

Next to the problem of providing transportation to the dam site is the problem of unwatering the dam foundations. The river is divided into two channels at the dam site, one on the west side of a small island, 350 feet wide, and the other on the east side, about 120 feet. The plan is to close the small channel first, build a cofferdam across the main or west channel high enough to force the water to pass over the dam in the small east channel during the entire construction of the dam in the west channel. The west channel part will contain ten sluice gates and when this part has been completed these will be opened and the section of the dam in the east channel will be carried to the proper height.

The quantity of excavation at the dam site is comparatively small, being about 700,000 cubic yards of rock and 14,000 cubic yards of earth. The amount of masonry in the dam will be about 70,000 cubic yards. A suitable quarry has been located within a thousand feet of the dam site which will supply stone for the concrete. The rock from the quarry will be dug with a steam shovel and dumped directly into a large crusher. A combination mixing and crushing plant is located on a steep hillside very close to the dam and will furnish material directly to it. Concrete forms, stones, machinery, etc., will be handled by two overhead cable ways and four derricks standing on cribs on the downstream side of the dam. A sawmill has been erected at the dam site and about 4,250,000 board measure of timber has been cut during the winter and delivered, in booms, at the dam site. All lumber required for erection purposes will be sawed at the plant. Oil burning locomotives will be used on standard gauge tracks, to eliminate the danger of fire in the woods along the right of way.

Hydro-Electric Power for Construction

A hydro-electric plant of 1,150 h.p. is being erected by the contractors to furnish power for the construction work. The location selected is the La Loutre Rapids, 2¼ miles below the dam site. The machines to be installed have two 39-in. wicket-gate wheels per unit, each unit to furnish 575 b.h.p. at 150 r.p.m. with a net head of 15 ft. The generators are 350 kv.a., three-phase, 2,400 volt, 60-cycle alternators with 14 kw., 125 volt exciters mounted on the main shafts.

The power house is being built of reinforced concrete and extends as a dam across a small channel of the river between two islands. Another channel is used as a spillway. The whole structure sits on solid rock, the draft tube and tailrace being excavated behind cofferdams built in November last year. This plant is practically ready for operation.

New Companies

The Sherwood Construction Company, Limited, Toronto, Ont., have been granted a charter.

The Montreal Forge & Shackle Company, manufacturers of metal, Montreal, Que., have registered.

Filtration Plant, St. Hyacinthe

The city of St. Hyacinthe, P.Q., with a population of about 15,000, will this year give further proof of its progressiveness by the installation of a mechanical filtration plant, to provide a plentiful supply of wholesome water to its citizens. At the same time additions to the pumping equipment will greatly improve the supply, both for domestic and fire service.

Present System

The present pumping equipment for domestic service consists of two centrifugal motor driven pumps, each having a capacity of 1¼ million gallons per day against a pressure of about 60 pounds per sq. in.

Fire service of about 120 pounds per sq. in. is obtained by operating these two pumps in series and by an additional centrifugal pump, which, operating against a pressure of 120 pounds per sq. in., has a capacity of 1¼ million gallons per day.

In addition to these three pumps, there is held in reserve a Holly steam pump, which is capable of supplying two million gallons per day, either for domestic or fire service. All pumps obtain their supply from the Yamaska River by means of a single 20-inch cast iron suction pipe, and discharge directly into the force mains supplying the city. There is no storage tank or reservoir connected with the system.

Proposed System

By the plans for the new work, water from the Yamaska River will reach the pumping station through two cast iron suction pipes, and will be lifted to the coagulation basins by four centrifugal pumps, each having a capacity of two million gallons per day. After passing through the coagulation basins, filters and filtered water reservoir, the water again returns to the pumping station.

A new two million gallon per day pump, in addition to the two existing domestic service pumps and the Holly steam pump, will supply filtered water for domestic service up to a maximum capacity of 6½ million gallons per day.

For fire service there will be installed a new four million gallons per day pump which, with the existing fire service centrifugal pump and the Holly steam pump, will supply water at 120 pounds pressure per square inch up to a maximum rate of 7¼ million gallons per day.

Coagulation Basins

Two coagulation basins are contemplated, with a combined capacity of 400,000 gallons. Each basin is 66 ft. x 32 ft. 3 in., inside measurements, and is of concrete construction throughout. These basins are entirely underground, with 2½ feet of earth fill over the reinforced concrete roof. Suitable provision is made for the regulation and control of the flow of water through the basins.

Filtered Water Reservoir

The filtered water reservoir, which is also of concrete construction and entirely underground, is 60 ft. x 39 ft., inside measurements, and has a capacity of 193,000 gallons. With an extension, proposed under a separate item, the reservoir will have a total capacity of 260,000 gallons. At one corner of the reservoir is a pump from which the pump suctions receive their supply of filtered water.

Filters

Four filter units, each with a nominal daily output of one million gallons, are located directly above and supported by the roof of the filtered water reservoir. The filters are located, two on each side of an operating and pipe gallery, which contains all piping and other equipment necessary for a modern installation.

Buildings

The filter building is 49 ft. 8 in. x 67 ft. 8 in., outside measurements, and encloses the filters, operating gallery, and a passage leading to the headhouse. The headhouse is located between, and connected with, the filter building and the existing pumping station. The lower floor is reserved for storage and chemicals. The upper floor contains the office, laboratory, and chemical room.

All buildings have brick walls and wooden roofs, and conform in style and architecture and other particulars, to the existing buildings. Windows are large and numerous, to make the interiors light and attractive. Electric lighting and steam heating systems are provided for in the contract.

Miscellaneous Equipment

The plans and specifications for the work include all piping and drainage systems and miscellaneous equipment, including wash water pump, blower, strainer, and air systems, controllers, operating tables, coagulant apparatus, chlorine apparatus, etc., required to make the plant complete and ready for service.

The work will be done under the general direction of Mr. Rene Morin, Mayor, and Mr. T. A. St. Germain, President of the Aqueduct Committee. Plans and filtration engineer.

Adjustable Shore

The cut shows a handy, light, adjustable shore, that can be readily built and should prove useful to contractors in supporting forms for concrete work. It consists of a pipe with timber extensions. On the top of the pipe is bolted a guide which runs between the

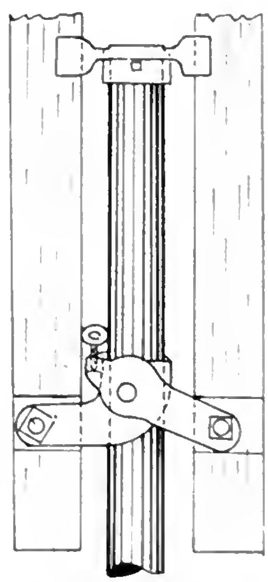


Diagram of Adjustable Shore.

2 x 4 in. extensions; at the lower extensions a self-locking plant is bolted. The shore is raised to the required height and when the weight is applied the clamps grip the pipe, the heavier the load, the tighter the grip. The thumbscrew lock prevents the shore from slipping.

Road Maintenance

Now that extensive road building is progressing in all parts of the Dominion, it might not be out of place to reiterate a few words concerning road maintenance. This problem is closely related to the movement for the construction of good roads, but the regrettable feature of the movement is that, as a rule, no provision is made for the upkeep of the roads after their construction. The result is, all too frequently, that many admirable highways have, after a few years, fallen into such a state of dilapidation that to repair means practically to reconstruct them.

The question of maintenance, as it is now understood, is of comparatively recent origin. It owes its inception, along with the good roads movement, to the advent of heavy and speedy motor traffic. With the roads of pre-motor times, subjected only to the action of slow and light traffic, the maintenance problem was of more or less secondary importance, but when the automobile appeared as a factor, the resulting rapid wear demanded urgent consideration of the question. Although from year to year it has been brought more forcibly to bear on the attention of the people, there has seemed to be a disinclination to meet it or to supply the funds necessary for effectively carrying it out.

Motor traffic, in entirely recasting the standard of road building, has imposed more solid and expensive construction which, in turn, has necessitated more costly upkeep. And not only is deterioration due to normal wear, but it also takes place from weathering conditions, such as action of frost, spring floods, and deterioration of the bituminous coating

The present poor condition of many roads is due to a failure to realize that road maintenance must begin where road construction leaves off, so that no wear will have a chance to get a grip. The old adage "a stitch in time saves nine" applies with special aptness to road maintenance. It means constant and vigilant care to counteract the effect of traffic or weather. In many cases authorities seem to feel that their duty has ended when a highway passes out of the hands of the contractor, and they fail to provide sufficient funds or labor to keep the road in its proper original condition.

County and municipal officials and engineers are now realizing more and more the extent of their duties. They are beginning to feel that it pays to maintain rather than re-surface or entirely reconstruct their roads every few years. In some municipalities the more solid concrete or brick pavements are being considered which, although higher in first cost, reduce maintenance charges to a minimum.

The method and cost of road upkeep depends on the nature of the road and its condition, and the work must be so carried out as to ensure the most effective treatment in each individual instance. In most cases, careful repair of all ruts, holes and surface breaks, is all that is necessary, with an application of a surface binder at sufficient intervals. Even the common surface application, crude oil, when applied immediately upon completion of a road renders it less pervious to the wearing effects of heavy traffic.

The question that municipalities must consider when formulating their good roads schemes is that the money spent will be of little avail unless they are prepared to back it up by a sufficient outlay to maintain their highways as permanent works from year to year. They must realize that maintenance is equally as important as the original construction and that only by effective maintenance can they realize the full value of a good road system.

Mainly Constructional

East and West—From Coast to Coast

The new C. P. R. depot at North Toronto has just been opened to the travelling public.

During the month of May, 21 building permits were issued in the city of Moncton, N. B., representing a value of $28,175.

The total amount of the building permits issued during the month of May this year in Chatham, Ont., was $28,350, as compared with $24,735 in May, 1915.

Building permits to the value of $144,441 were issued during the month of May this year in the city of Halifax, N. S., as compared with $113,270 for May, 1915.

A. R. C. Clark has been awarded the contract for the construction of the N. B. Telephone Company's new exchange at West St. John. It will cost about $12,000.

Letters Patent of incorporation have been issued to Westman Hardware, Limited, the capital of the company being $40,000. Their head office will be at London, Ont.

The foundry at Beauceville, Que., which recently came under the management of Messrs. Marcoux and Poirier, has been destroyed by fire, resulting in an estimated loss of $12,000.

The St. Mary's River Construction Company, Limited, has been incorporated, with a capital of $25,000, to carry on the business of general contractors, head office at Sault Ste. Marie, Ont.

The Royal Connaught Hotel, which has just recently been completed in Hamilton, Ont., has now thrown its doors open to the public. It is considered one of the most modernly equipped hotels in the Dominion.

Mr. J. D. Buckley is erecting a large refuse burner at his French Fort Cove mill, near Newcastle, N. B. It will be 110 feet high and 32 feet in diameter at the base. The contractors are Mooney & Sons, of St. John. The burner will cost about $7,000.

The Regina Builders' Exchange at a recent meeting passed a unanimous resolution not to accede to the demands of the Bricklayers' Union that the hours of labor be 9 hours per day, except on Saturdays, when work would cease at 1 p.m., and the rate be 75c. per hour.

The Nova Scotia Construction Company, who were awarded the contract for the completion of the forty-mile section of the Valley Railway between Gagetown and Westfield, have sublet the contract in ten mile sections to Kennedy & McDonall, Poupore Bros., Lynch & Gorman, and Smith and Merrithew.

The tender of the Dominion Bridge Company for the superstructure of the Pretoria Avenue bridge in the city of Ottawa, $84,158, has been accepted by the city council. Owing to the rapid rise in the price of steel, this amount is much above the original estimate. The work on the bridge will occupy about 18 months.

Several towns along the line between Borden and North Battleford, in the Province of Saskatchewan, are endeavoring to obtain the right of way between those two points, a distance of 60 miles, for the construction of a highway, the object being eventually to extend this road and make a great highway from Saskatoon to North Battleford.

The Dominion Textile Company, Limited, of Montreal, have sold its buildings and real estate in Moncton to the biscuit manufacturing firm of J. A. Marven Limited. The Textile Company is removing the cotton machinery from the main building, after which the Marven firm will fit it up for biscuit manufacturing on a more extended scale.

Work on the Centre Street bridge in Calgary, Alta., is progressing satisfactorily. Three of the spans have now been completed, and the men are now at work finishing the ornamental towers which will rise at either end of the centre span. The fourth, and southernmost, will not be constructed until the last possible danger of spring floods is over.

A bill to grant to the Dominion Government the strip of land necessary for the construction of the Banff-Windemere highway was passed recently by the legislature of the Province of British Columbia. This road will be about 40 miles long and will cost about $200,000. The Dominion Government have agreed to complete and maintain the road.

Judge Demers has confirmed the appointment of engineering arbitrators in the litigation between the city of Montreal and the Harris Construction Company. This has reference to work done for the city, the amount involved being nearly $100,000. Mr. H. E. Vautelet will represent the city, Mr. Emile Vanier, the contractors. Dr. L. A. Herdt is the third engineer appointed by the court.

During the month of May this year there were 217 building permits issued in the city of Winnipeg, Man., representing a value of $395,700, as compared with 218 last year, representing a value of $135,000. The total for the first five months of the year is $1,135,400, as compared with $640,150 in 1915. There are also extensive building operations going on this month, including Stovel's new building, $160,000.

In connection with the work on the St. Maurice River dam in the Province of Quebec, several camps have been constructed on a large area of land cleared at the site for that purpose. In order to facilitate navigation on the river for the transportation of material, a temporary dam is under construction at Manouan. A telephone line from Manouan to the scene of operations, a distance of 32 miles, has also been installed.

Kane & Ring, contractors, have been awarded the contract for the construction of permanent sidewalks in the Fairville district of St. John County. About 20,000 feet of sidewalks will be laid. Fairville is developing rapidly, both as an industrial and residential district. The completion of the new highway bridge at the Falls and the promise of an improved water service have given a considerable impetus to its development.

Three tentative sites for the proposed grain elevator to be erected in the place of the I. C. R. St. John, N.B., elevator destroyed in 1914, have been submitted to the city council by general manager Gutelius, of the Canadian Government Railways, to make a selection from. One site is just south of the custom house; the other two are adjacent to the sugar refinery. The council has held two meetings on the subject, but has not reached a decision.

The council of Bassano, Alta., have threatened to take steps to force the city of Calgary to install a sewage disposal plant in order to protect the water for their use. It appears that Calgary received instruction from the government to proceed with such a plant some time ago, but the declaration of war caused delay. The city engineer, however, has now been instructed to prepare a report in this connection, and the construction of the plant is to commence when the war is over. It will cost about $300,000.

Owing mainly to the diversion of men to ammunition plants there is an acute shortage of unskilled labor in Montreal which is affecting the building trade. Combined with this cause is the internment of aliens, the recruiting, the calling up of men by the warring nations, and the small immigration. The labor agencies are able to supply only a very small portion of the needed labor. At a meeting of the directors of the Builders' Exchange it was stated that one quarry company which offered good wages, free transportation, constant work and sleeping accommodation, had not been able to obtain 25 men to go a short distance out of town.

Building permits to the amount of $24,570 were issued in Medicine Hat, Alta., during the month of May. Amongst these is included a building for the Alberta Foundry and Machine Company, $20,000, which will be built of brick and steel. It will have a frontage of 160 feet and a depth of 120 feet, and will include foundry, machine shop and offices. It will be heated by steam and supplied with electric power and lighting. The new building will be put up over the present plant, in order to avoid any interference with the progress of work, and after completion the old shops will be taken down. The permits for May, 1915, only amounted to $2,510.

Following a tour of inspection of the Toronto Harbor work, in which Hon. Dr. Reid, acting Minister of Public Works; the Harbor Commission, the City Council and a number of members of the Board of Trade participated, the chairman of the Commission, Mr. Lionel H. Clarke, made the announcement that a saving of over $1,000,000 was being made in connection with the reclamation of Ashbridge's Bay and the establishment of an industrial area there. In this area between two and three hundred acres have been reclaimed which practically completes the work. The estimated cost of this operation was $5,000,000, but according to Mr. Clarke's statement the actual expenditure will not reach $4,000,000. The chairman also mentioned the fact that during the last twelve months the Commission has increased the harbor property by 230 acres by acquisition from the Government, the C. P. R. and the Grand Trunk.

While in the city of St. John, N.B., recently, Mr. H. P. Timmerman, industrial commissioner of the C. P. R., announced that his company had engaged the well-known U. S. engineering firm of Arthur D. Little to take up research work on lands adjacent to the C. P. R. track in Canada. The object of these researches will be to ascertain the commercial values of ores or other mineral or chemical deposits that may be discovered contiguous to the railway, and which might form the basis of industrial enterprises. It frequently happens that discoveries of such natural resources are made by men who either do not appreciate their value, or who lack the capital to test them commercially. This work will be taken up by Mr. Little's research department and the information secured will form the basis for bulletins that will be issued by the company from time to time. Mr. Little is an ex-president of the American Chemical Society.

Personal

Company Sergeant-Major Armstrong has been killed in the recent fighting. He was a graduate in science of McGill University. Prior to joining the forces he was on the engineering staff of the city of Montreal.

Mr. E. L. Cousins, who has been engineer to the Toronto Harbor Commission, has just been promoted to the position of general manager, a reorganization of the office staff having been made necessary by the enlistment of Major Alex. Lewis, who had acted as secretary since the inception of the Commission.

Capt. Frank P. Adams, of the 186th overseas battalion, who for several years has been city engineer of Chatham, Ont., was recently honoured, on the occasion of his departure for the training camp at London, by the city councils of 1913-14-15-16, under whose direction he served. He was presented with a purse of gold, and members of the respective councils made brief addresses complimenting him on the efficiency and courtesy which he had always shown and the very satisfactory service he had rendered the city.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

North Bay, Ont.
The Town Engineer, H. J. McAuslan, will receive tenders until noon, June 28th, for the construction of about 50,000 square feet of sidewalks.

Norwich, Ont.
The Town Council propose to lay about 40,000 square feet of brick pavement on concrete foundation. Clerk, William Fairley.

Pembroke, Ont.
The Town Council are having plans prepared for permanent pavements, estimated to cost $4,000. Engineer, W. J. Moore.

Quebec, Que.
The City Council are considering the paving of Sauvageau and Aqueduc Hills, at an approximate cost of $5,300. Engineer, W. D. Baillarge.

St. Hyacinthe, Que.
A by-law has been passed providing for the construction of paving estimated to cost $25,000, and for a quantity of side walk. Engineer, H. Cadieux.

Toronto, Ont.
Commissioner of Works R. C. Harris has recommended the construction of asphalt paving to cost about $36,665, and bitulithic to cost $13,074.

Victoria, B.C.
The City Council propose to lay a watermain to the premises of the Esquimalt Waterworks Company. Estimated cost, $5,000. Engineer, C. H. Rust.

CONTRACTS AWARDED

Markham, Ont.
The Town Council have awarded the contract for the construction of a gravity main and collecting basin to Murphy & Barnes, 23 Temple Avenue, and the contract for supply of pipe to the National Iron Company, Toronto.

Ottawa, Ont.
The City Council have awarded contracts to the Union Construction Company, Bank Street Chambers, for the construction of asphalt pavement on Napean and Albert Streets, estimated to cost $41,160.

Quebec, Que.
The City Council have let the following contracts: asphalt paving on St. Foye Road, Quebec Paving & Construction Company, 70 Tenth Avenue, Limoilou; scoria block on Henderson, Ramsay, and Orleans Place, George Madden, 822 St. Valier Street; scoria block and granite block on Bridge Street, partly to George Madden and Quebec Paving & Construction Company; roemac on St. Olivier Street, G. Michaud, 90 Des Forges Street.

St. Catharines, Ont.
The City Council have awarded a contract for construction of a trunk sewer to John Maguire & Son, Spadina Road, Toronto. Estimated cost, $64,589.

Welland, Ont.
The contract for construction of a sewer on Burgar Street has been awarded to Louis Sacco. Approximate cost, $3,520. Contractor requires 6, 8 and 10-inch pipe.

Railroads, Bridges and Wharves

McNab Township, Ont.
Plans have been prepared by J. T. Morris, Pembroke, for a bridge to be built over the Madawaska River for the Township and Renfrew County Council. Estimated cost, $10,000.

Toronto, Ont.
The Toronto Harbor Commissioners have had plans pdepared for a steel bascule bridge to be constructed across the Don Diversional Channel at the foot of Cherry Street. Chief Engineer, E. L. Cousins, 50 Bay Street.

CONTRACTS AWARDED

Arden, Man.
The municipalities of Lansdowne and Langford have awarded the contract for construction of a concrete bridge to the Brown Construction Company, 302 Tribune Building, Winnipeg. Approximate cost, $5,500.

New Brunswick Province.
The Provincial Department of Public Works have awarded to W. R. Fawcett, Sackville, contracts for the contsruction of the Nicholas River bridge and for new substructure and general repairs to Upper Sackville and Anderson bridges. Approximate total cost, $41,000.

South Dumfries Township, Ont.
The contract for steel work required in the construction of a bridge over Maniwarring Creek for the Township Council has been let to Hamilton Bridge Works Company, Ltd., Bay Street North, Hamilton, at $2,100, and abutments to Bain & Ross, Embro, at $958.

Upper Jemseg, N.B.
The Department of Public Works, Fredericton, have awarded the contract for construction of substructure and approaches of a steel truss bridge to Joseph McVay & Sons, St. Stephen, N. B. Approximate amount of contract, $20,000.

Public Buildings, Churches and Schools

Anderdon Township, Ont.
Plans of a school are being prepared for the Trustees of School Section No. 6 by Jacques & Company, Boug Building, Windsor. Frame construction. Estimated cost, $5,000.

Beeton, Ont.
Bulk or separate tenders on the erection of a school will be received until June 30th by the Secretary to the School Board, J. N. Lannin. Approximate cost, $15,000. Architect, John Wilson, Collingwood. Plans with the Secretary, the Architect, and at office of the Contract Record, 347 Adelaide Street West, Toronto.

Cainsville, Ont.
Tenders on the erection of a church for the Baptist Congregation will be received until June 24th by the Architect, L. D. Barber, Temple Building, Brantford. Brick construction. Approximate cost, $6,000.

Calgary, Alta.
The Congregation of Central Methodist Church propose to replace their building, recently destroyed by fire, with a new structure to cost about $40,000, and to instal an organ at an approximate cost of $15,000. Nothing definite is yet decided.

Eganville, Ont.
The Evangelical Lutheran Congregation are building a church under supervision of R. G. Reinke. Frame construction, venecred with concrete block. Approximate cost, $12,000. Architect, Bruno Michel, Carleton Place, Ont.

Halifax, N.S.
The Board of School Commissioners propose to build a school on Morris Street, and plans will be prepared by W. J. Buash, 60 Bedford Road. Cost will probably exceed $120,000.

Hamilton, Ont.
F. W. Warren, Bank of Hamilton Building, is preparing plans for an Interdenominational Church, estimated to cost $9,000. Tenders will be called shortly. Cut stone, steel, and brick construction.

McGregor, Ont.
The Catholic School Trustees will call for tenders on the erection of an addition to the school, estimated to cost $5,000. Frame construction. Particulars from Father J. A. Pinsonneault.

Mindemoya, Ont.
The Methodist Congregation are about to start work on the erection of a Church, estimated to cost $3,000. Stone construction. Chairman of Building Committee, D. Wyman.

Montreal, Que.
The Commissioners of St. Gregoire le Thaumaturge will receive tenders until June 26th for the erection of a school, estimated to cost $250,000. Architect, C. Bernier, 70 St. James Street.

New Liskeard, Ont.
The School Board propose to build a school at an approximate cost of $30,000. Town Clerk, J. I. Dixon.

Ottawa, Ont.
Tenders on the erection of a laundry and dormitory for the Grey Nuns of the Cross will be received until June 26th. Plans at the Hospital or at office of the Architect, Charles Brodeur, 63 City Hall Street, Hull, Que. Approximate cost, $50,000.

Otterville, Ont.
The Township of South Norwich propose to build a Library, and have been promised a grant of $6,000 by the Car-

negie Corporation. Clerk, Alexander Macfarlane.

Peace River, Alta.
The Department of Public Works, Ottawa, have prepared plans for an Immigration Hall, estimated to cost $5,000. Frame construction. Secretary, R. C. Desrochers, Ottawa.

Peterborough, Ont.
Tenders on steel valley trusses for the roofing of St. James Methodist Church are being received by the Secretary to the Building Committee, A. E. Prest, 242 Lansdowne Street.

Port Colborne, Ont.
Tenders are now being received for the erection of St. James Church, according to revised plans. Architect, C. M. Borter, Niagara Falls, Ont. Estimated cost, $18,000.

Sudbury, Ont.
Tenders on all trades required in the erection of a school on College Street will be received until June 30th by the Architect, V. L. Morgan, Wilson-Greenwood Block. Plans and specifications with the Architect, and at office of MacLean Daily Reports, Ltd., 25 Charlotte Street, Toronto.

Timmins, Ont.
Ellis & Ellis, Architects, Manning Chambers, Toronto, are preparing plans for a school, estimated to cost $40,000. Hollow tile and brick construction.

Toronto, Ont.
A site in Queen's Park has been purchased for the erection of new premises for St. Michael's College, St. Joseph Street. Stone construction. Approximate cost, $350,000. Registrar, Rev. Father H. Carr.

The Board of Education have cancelled the contract for plastering at the Park School, and are now receiving new tenders. Plans and specifications at office of the Superintendent of Buildings.

Weston, Ont.
Tenders on the erection of a hospital cottage for the National Sanitarium Association are now being received by the Architect, C. S. Cobb, 71 Bay Street, Toronto. Brick construction. Approximate cost, $6,000.

Wiarton, Ont.
Tenders will be received until June 29th for the erection of an addition to the High School, installation of a lavatory system and construction of a sewer. Plans and specifications with the Secretary to the High School Board, W. M. Newman, and the Architects, Forster & Clark, 887 Second Avenue E., Owen Sound.

CONTRACTS AWARDED

Berlin, Ont.
The contract for steel work required in the erection of a Polish Roman Catholic Church has been awarded to the Dominion Bridge Company, 20 Victoria Street, Toronto, and the masonry to Wunder Brothers, 20 Peter Street.

Chatham Township, Ont.
The general contract for the erection of a school for Union School Section No. 15 has been let to Chester McGregor, Wallaceburg. Brick construction. Approximate cost, $3,950.

Hamilton, Ont.
The contract for supply of seating required for the Robert Land School has been let to the Globe Furniture Company, Shantz Avenue, Waterloo.

The contract for masonry required in alterations to Christ's Church Cathedral has been awarded to Mitchell & Riddell, 46 Head Street. Approximate cost, $15,000. Architects, Stewart & Witton, 7 Hughson Street.

Leamington, Ont.
The County Council have awarded the contract for remodelling the House of Refuge to A. E. Law, Leamington, on a 10 per cent. basis. Estimated cost of work, $5,000.

Mount St. Patrick, Ont.
Work has been started on the erection of a convent for the Roman Catholic Congregation. The contract for masonry and brick veneering has been let to Anthony Coulas, Springton Post Office. Frame and brick veneer construction. Approximate cost, $6,000.

North Vancouver, B.C.
The following contracts have been let for work required in the erection of an addition to the North Lonsdale School: plastering, A. Clarke; tinsmithing, G. Johanson; painting, C. Musson; electrical work, W. Graves; heating and plumbing, J. Young; carpentry by day labor.

Orillia, Ont.
The contract for heating and plumbing required in the erection of the Municipal Building, has been awarded to E. A. Latimer, West Street.

Oyen, Alta.
The Trustees of School Section No. 3058 have awarded the general contract for the erection of a school to the Alberta School Supply Company, 10125 104th Street, Edmonton. Brick construction. Approximate cost, $5,500.

Quebec, Que.
The Protestant School Board have let the contract for repairs to the Desjardins School to Emile Cote, 360 Richelieu Street. Estimated cost, $3,000.

The general contract for interior repairs to the chapel of Fabrique Notre Dame, 16 Buade Street, has been let to C. E. Morissette, Ltd., 208 Latourelle Street. Approximate cost, $3,000.

Sacre Coeur, Que.
The general contract for repairs to the Parish Church has been let to Charles Belanger, St. Simon Street. Approximate cost, $4,000.

Sault Ste. Marie, Ont.
The general contract for alterations and additions to the Furse Business College has been awarded to McPhail & Wright, Sault Ste. Marie. Estimated cost, $7,000.

St. Michel, Que.
The general contract for the erection of a Presbytery for the Parish has been let to W. Beauchamp, 1559 Bordeaux Street, Montreal. Approximate cost, $8,500.

Toronto, Ont.
The contract for brick work required in the erection of Boon Avenue Baptist Church has been awarded to F. & A. E. Ham, 83 Salem Avenue, and carpentry to A. C. Smithers, 121 Greenlaw Avenue. Tenders on plumbing and tinsmithing are now being received by carpentry contractor.

The Board of Education have let the contract for plastering at Dovercourt School to William Gayton, 31 Malvern Avenue, at $3,999.

Windsor, Ont.
In connection with the erection of an addition to the College, the contract for supply of 85,000 red vitrized face brick has been let to the Chick Contracting Company, McDougal Street, at $18 per thousand, and a contract for buff brick at $19.

Winnipeg, Man.
The contract for repairs to the Point Douglas Presbyterian Church has been awarded to the Sutherland Construction Company, 206 Carlton Building, on a percentage basis. Approximate cost, $4,000.

The contract for the erection of a Church for St. George Anglican Congregation has been awarded to Claydon Brothers, Furby Place. Frame construction. Approximate cost, $7,500. Architects, J. D. Atchison & Company, 914 Boyd Building.

Business Buildings and Industrial Plants

Auburn, Ont.
E. Helwig is considering the erection of a store and residence on Main Street, at an approximate cost of $3,000. Frame and white brick construction.

Chatham, Ont.
Tenders on the erection of a factory for the American Textile Company will be called about the end of the month by the Architects, Adams & Adams, Market Building. Brick construction. Approximate cost, $30,000.

Chicoutimi, Que.
A Lapointe is about to build a store and residence, estimated to cost $4,000. Brick construction.

Cobden, Ont.
Walter Stitt, Cobden Post Office, has commenced the erection of a store on Main Street, estimated to cost $4,000. Brick construction.

L'Islet, Que.
J. A. Dionne is remodelling his store and residence. Estimated cost, $12,000.

Moncton, N.B.
The Atlantic Underwear Company, Ltd., are building an addition to their premises, under the supervision of R. C. Donald. Estimated cost, $6,000.

Montreal, Que.
The Canadian Northern Railway, St. James Street, have commenced the erection of a freight shed on Stadacona Street, estimated to cost $3,000.

Norwich, Ont.
M. L. Bushell has commenced the erection of an office and residence, estimated to cost $3,000. Brick construction.

Ottawa, Ont.
Work has been started by A. D. Hudon, Clarkstown, Ont., on the erection of stores and residence, estimated to cost $8,000. Tenders are being received for the smaller trades. Brick veneer construction.

Quebec, Que.
The Premier Feature Film Company of Canada, St Bridhe Street, propose to build a studio, and have secured a site. Brick and stucco construction. Approximate cost, $50,000.

Revelstoke, B.C.
The Farmers' Co-operative Association are considering the erection of a creamery, estimated to cost $3,000.

Simcoe, Ont.
William Tilley, Architect, Temple

Tenders and For Sale Department

Tenders Wanted

Sealed bulk and separate tenders addressed to the undersigned will be received up till five p.m., **June twenty-fourth, 1916**, for the several works required for the erection of a new School Building in Selkirk, Ontario. Each tender must be accompanied by a certified cheque for ten per cent. of the amount of tender, which will be forfeited should the contractor refuse to sign contract and complete the same.

Plans and specifications may be seen at the office of the undersigned or at the office of the Architect, A. W. Peene, 107 Clyde Block, Hamilton, Ontario. The lowest or any tender not necessarily accepted.

J. E. HOOVER, Sec.-Treas.,
Box 18, Selkirk, Ont.

June 1st, 1916. 23-25

Extension of Time

TENDERS

Sealed tenders will be received up to 6 p.m. of **Thursday, June 22, 1916**, by the Secretary, for the erection and completion of a six-room school building to be built in Parry Sound, Ont., for the Parry Sound Public School Board.

Plans and specifications may be seen at the office of the Secretary-Treasurer, Parry Sound, Ont.; the office of the Contract Record, 347 Adelaide Street West, Toronto, Ont., and at the office of the Architects, Angus & Angus, Angus Block, North Bay, Ont.

The successful contractor will be required to furnish a satisfactory guarantee.

The lowest or any tender not necessarily accepted.

J. D. BROUGHTON,
Sec-Treas., Parry Sound Public School Board,
21-25 Parry Sound, Ont.

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Supplying Coal for the Dominion Buildings," will be received at this office until 4 p.m. on **Wednesday, June 28, 1916**, for the supply of coal for the Public Buildings throughout the Dominion.

Combined specification and form of tender can be obtained at this Department and on application to the caretakers of the different Dominion Buildings.

Persons tendering are notified that tenders will not be considered unless made on the printed forms supplied, and signed with their actual signatures.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so or fail to complete the contract. If the tender be not accepted the cheque will be returned.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, June 7, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 24-25

Tenders addressed to the undersigned will be received by registered post only up to noon on **Tuesday, July 4th, 1916**, for the supplying of

ONE 3 H.P. PHASE MOTOR; ONE 20-INCH SQUARE BASE SELF-FEED VERTICAL DRILL WITH ¾-INCH DRILL CHUCK AND SHAFTING.

Samples of the several articles can be seen and forms of tender obtained upon application at the office of the Fire Department, Adelaide Street Fire Hall, Toronto. The usual conditions relative to tendering as prescribed by city by-law must be strictly complied with or the tender will not be entertained. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
25-25 Chairman, Board of Control.

Tenders Wanted

Sealed tenders will be received up to noon on **Monday, July 10th, 1916**, for the construction of a Municipal Drain in the Township of Minto, known as Municipal Drain No. 7, approximately **12,411** feet long.

Plans, profiles and specifications can be seen at the office of C. D. Bowman, O.L.S., West Montrose, or at the office of the undersigned, to whom the tenders must be addressed.

A marked cheque for the sum of $150 must accompany each tender as a guarantee of good faith. The lowest or any tender not necessarily accepted.

W. D. McLELLAN,
Clerk of Minto,
Harriston, Ont.

Harriston, June 19th, 1916. 25-27

CANADIAN GOVERNMENT RAILWAYS

TENDERS

Sealed tenders, addressed to J. W. Pugsley, Secretary, Department of Railways & Canals, Ottawa, Ont., and marked on the outside "Tender for Elevator Foundations, Transcona," will be received up to and including twelve o'clock noon, **Tuesday, July the 4th, 1916**, for the construction of reinforced concrete foundations on wood piles or concrete piles, for 1,000,000 bushel storage capacity Grain Elevator. Working Houses and Track Shed at Transcona, Manitoba; separate tenders to be submitted for the foundations with concrete piles and foundations with wooden piles, and tenders may be submitted on either or both designs.

Plans, specifications and blank form of contract may be seen at the office of the Chief Engineer of the Department of Railways & Canals, Ottawa; at the office of the Chief Engineer, Moncton, N.B.; at the office of the General Superintendent, Winnipeg, Manitoba; at the office of the Resident Engineer, Fort William, Ont.; and at the office of the J. S. Metcalf Company, Limited, Engineers, Montreal, P.Q.

All the conditions of the Specifications and contract form must be complied with.

Tenders must be put in on the blank form of tender, which may be obtained from any of the offices at which plans are on exhibition. Each tender must be accompanied by a certified bank cheque, payable to the Honorable the Minister of Railways & Canals, for the sum of $15,000.

The lowest of any tender not necessarily accepted.

F. P. GUTELIUS,
General Manager
Canadian Government Railways.

Dated at Moncton, N. B.,
June 17th, 1916. 25-26

Hydro Tenders Wanted

Sealed tenders, marked "Tenders for Extension to Front Street Sub-Station," and addressed to the Chairman, Toronto Electric Commissioners, will be received until noon of **Wednesday, June 28th**. Tenders will be considered from the various trades, also bulk tenders for the entire work. Tenderers wanting sets of plans must make a deposit of $10, which will be refunded after plans have been returned.

Plans, specifications and form of tender may be obtained at Engineering Office, corner Duncan and Nelson Streets. The lowest or any tender not necessarily accepted. 25-25

TENDERS

Tenders will be received until **Friday, June 30th, 1916**, by the undersigned, for all trades required in the erection and completion of a new Public School Building in College Street, Sudbury, Ontario. Plans may be seen and all information obtained at the office of the Architect, Victor L. Morgan, Wilson-Greenwood Block, Cedar Street, Sudbury, Ontario.

All tenders are to be sent in by Registered Mail and plainly marked on the outside, "Tender for new Public School, Sudbury," and must be accompanied by marked cheque for 5 per cent. of the amount of the tender.

The Board reserves the right to reject any or all tenders submitted.

The Sudbury Public School Board,
25-25 Per Joseph Fowler, Secretary.

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Examining Warehouse, Toronto, Ont.," will be received at this office until 4 p.m. on **Monday, July 17, 1916**, for the construction of the building mentioned.

Plans, specification and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. A. Hastings, Clerk of Works, Postal Station "F," Yonge Street, Toronto, Ont., Mr. R. L. Deschamps, Central Post Office, Montreal, P. Q., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, June 16, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 25-26

Tenders for Debentures

Sealed tenders will be received by the undersigned up to 8 o'clock p.m. on **June 27th, 1916**, for the purchase of $15,000 6 per cent. Debentures of the Corporation of the Village of Elmira, under By-law No. 366. No tender necessarily accepted.

J. H. RUPPEL,
Clerk.

24-25

Tenders for 4-in. Stop Valves

Tenders will be received by registered post only, addressed to the Chairman, Board of Control, City Hall, Toronto, up to 12 o'clock noon on **Tuesday, July 4th, 1916**, for the supply and delivery of:

4-in. Stop Valves for High Level Pumping Station. Tender No. 48.

Envelopes containing tenders must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, Room 12, City Hall. Tenders must comply strictly with conditions of City By-laws as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH, Mayor,
Chairman, Board of Control.

25-25

Board of Education

Sealed tenders, whole or separate, addressed to the Secretary-Treasurer of the Board of Education, will be received until

Thursday, June 29th, 1916

for

Midsummer Repairs, Sundry Schools in the following trades:

Roofing, Tinsmithing, Iron Stairs, Exterior Painting, Plumbing, Steam Fitting, Electrical Work, Cabinet Work, Local Telephones, Tinsmith's Stoves and Furnace Work.

Specifications may be seen and all information obtained at the office of the Superintendent of Buildings, City Hall, Toronto. Each tender must be accompanied with an accepted bank cheque for five per cent. of the amount of tender or its equivalent in cash, applying to said tender only. Sureties for all tenders exceeding four thousand dollars must be furnished by Surety Companies. Tenders must be in the hands of the Secretary-Treasurer at his office in the City Hall, **not later than 4 o'clock** on the day named, after which no tender will be received. The lowest or any tender will not necessarily be accepted.

MILES VOKES,
Chairman of Property Committee
W. C. WILKINSON,
Secretary-Treasurer.

25-25

FOR SALE

Marion Revolving Shovel, Model No. 30, on railroad trucks, in fair condition. Box 413, Contract Record, Toronto, Ont. 23-25

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

Plant For Sale

1 Smith Concrete Mixer	$400
1 Wettlaufer Mixer with Engine	250
1 20-H.P. Upright Hoisting Engine ...	450
2 10-H.P. Motors, D.C. ... ... each	85
1 30-H.P. Motor, D.C.	150

HOLMES, 1107 Yonge Street, Toronto.

22-t.f.

Tenders for School

Sealed tenders, addressed to the undersigned, will be received up to 7 o'clock p.m., on **Friday, June 30, 1916**, for the erection of a four-roomed School Building. Separate tenders for the following trades:

1. Excavating and concrete work.
2. Brick work.
3. Carpenter work.
4. Lathing and plastering.
5. Painting and glazing.
6. Galvanized iron work, roofing and roof conductor.
7. Plumbing.
8. Heating and ventilation.

Also bulk tenders for the entire work.

Plans and specifications may be seen at the office of John Wilson, Architect, Collingwood, and at the office of the "Contract Record," Toronto, or with the undersigned. All tenders must be accompanied by a marked cheque, made payable to the Secretary-Treasurer of the Beeton School Board, for 5 per cent. of the amount of the tender. The lowest or any tender not necessarily accepted.

JOHN N. LANNIN,
Secretary.

Beeton, Ont., June 14, 1916. 24-25

Building, Brantford, will receive tenders until June 28th for the erection of a factory for the Unique Shoe Company. Brick construction. Approximate cost, $10,000.

St. Rosalie Junction, Que.

Plans of a warehouse to cost about $12,000 are being prepared for Societe Co-operative des Producteurs des Semence, and private tenders will be called shortly. Architect, P. Myrand, Department of Agriculture, Parliament Buildings. Frame construction.

Stratford, Ont.

The Stratford Davenport Company, Ltd., 552 Ontario Street, propose to make repairs to their premises, which were recently damaged by fire. Estimated cost, $3,000.

Timmins, Ont.

Ellis & Ellis, Manning Chambers, Toronto, are preparing plans of a hospital for the Canadian Mining & Furnace Company. Estimated cost, $30,000. Hollow tile and brick construction.

Toronto, Ont.

Tenders on the erection of an examining warehouse on Front Street West will be received until 4 p.m., July 17th by R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Plans and specifications at office of T. A. Hastings, Clerk of Works, Postal Station F, Toronto, and at the Department. Specifications only at office of MacLean Daily Reports, Limited, 25 Charlotte Street, Toronto. Approximate cost, $500,000.

Plans have been prepared for an addition to a factory on Williams Street for L. White & Sons, 270 Queen Street W., and tenders will shortly be called. Architect, B. Brown, 37 Yonge Street. Approximate cost, $4,000.

H. J. Chown, 220 Scarboro Road, has prepared plans of a garage for H. A. Zimmerman, 875 Kingston Road. Brick and steel construction. Estimated cost, $5,000.

Plans for a store and residence estimated to cost $5,000 have been prepared for Linder Brothers, 1430 Queen Street W. Brick construction.

The Toronto Hydro Electric Commissioners, 226 Yonge Street, will receive tenders until June 28th for the erection of an addition to the Front Street Sub-station. Plans at office of the Engineering Department, Duncan and Nelson Streets. Brick and steel construction. Approximate cost, $8,000. The Commission are also having plans prepared for an addition to the Stanley Park Sub-station, estimated to cost $12,000.

G. D. Redmond, 35 Fairview Boulevard, has prepared plans of a picture theatre to be built on Gerrard Street East, and will shortly call for tenders. Approximate cost, $25,000. Steel, artificial stone and brick construction.

CONTRACTS AWARDED

Berlin, Ont.

In connection with the erection of a factory for the Canadian Regal Motor Company, Ltd., the masonry has been let to Peter Cragnoline, 386 East King Street, and carpentry to W. H. Danker & Son, 58 Louisa Street.

Halifax, N.S.

In connection with alterations to a restaurant for Bonds Limited, Barrington Street, the contract for heating has been awarded to Longard Brothers, 213 Hollis Street; plumbing to W. J. Craig, 316 Upper Water Street, and electrical work to J. Starr, Son & Company, Granville Street.

Hamilton, Ont.

In connection with the office building now in course of erection for the Stanley Steel Company, the contract for heating and plumbing has been let to Buchanan & MacBeth, 314 King Street E., and the plastering to the general contractor.

Port Arthur, Ont.

The general contract for alterations to the Ottawa House for C. H. Roy, has been let to R. Hamer, 214 Park Street, heating and plumbing to J. Marshall, and electrical work to Mahon Brothers, 238 Arthur Street.

Quebec, Que.

The Quebec Construction Company, 111 Mountain Hill, have started work on the conversion of a store into bowling alleys for D. Brochu, 63 St. John Street. Estimated cost, $3,000.

Regina, Sask.

The general contract for the erection of a roundhouse and storehouse for the Canadian Northern Railway has been let to George McLeod. Brick and concrete construction. Approximate cost, $15,000.

Saskatoon, Sask.

The contract for excavation and foundations required in the erection of a daylight theatre for J. A. Ashdown, 529 Wellington Crescent, Winnipeg, has been awarded to R. B. McLeod, 118 28th Street. Approximate cost of building, $50,000.

St. Boniface, Man.

The general contract for the erection of a block of stores and apartments for Lady Dubuc has been let to F. Grenon, 271 Cumberland Street, Winnipeg. Brick and stone construction. Approximate cost, $30,000.

St. Catharines, Ont.

The contract for painting required in the erection of a factory for the McKinnon Dash & Hardware Company, has been awarded to Begy & Son Company, James Street.

St. John, N.B.

The general contract for the erection of an exchange for the New Brunswick Telephone Company, Ltd., 22 Prince William Street, has been awarded to A. R. C. Clark, 51 Water Street, and the electrical work to Vaughan Electric Company, Ltd., 94 Germain Street. Approximate cost, $12,000.

Toronto, Ont.

The contract for masonry required in the erection of premises at Ossington Avenue and Arthur Street for the Bank of Toronto, has been let to J. A. Wickett Ltd., Traders Bank Building, and cut stone to Scott Brothers, 38 McGee Street.

Vancouver, B.C.

The contract for waterproofing required in the erection of the False Creek Station for the Great Northern Railway, has been awarded to Campbell & Grill, 331 Georgia Street E.

Welland, Ont.

The general contract for the erection of a storage building for Canadian Billings & Spencer, has been awarded to the Standard Steel Construction Company. Corrugated iron construction. Approximate cost, $8,000.

The Welland Motor & Machine Company have let the general contract for the erection of a factory to S. L. Lambert. Frame construction. Estimated cost, $3,500.

Windsor, Ont.

The general and roofing contracts for the erection of a block of stores and flats for H. Benstein, 134 Goyea Street, have been let to Urgil Jacques, 160 Dougal Avenue; masonry to Cross Brothers, Louis Avenue; plastering to Lossing & Harris, and heating and plumbing to Windsor Hardware Company, 71 Sandwich Street E.

Winnipeg, Man.

The contract for ornamental iron work required in the erection of a grain exchange for the Trades Building Association has been awarded to Dennis Wire & Iron Company, Ltd., 22 Dundas Street, London, Ont.

The general, masonry, carpentry, steel and roofing contracts for an addition to a theatre for A. R. McNichol, 292 Portage Avenue, have been let to Hazelton & Malin, 303 Donalda Street. Brick construction. Estimated cost, $12,000.

Residences

Appin, Ont.

James Glasgow has commenced the erection of a residence. Frame and white brick construction. Approximate cost, $3,000.

Brussels, Ont.

W. F. Stretton proposes to build a bungalow at an approximate cost of $3,000. Plans will be prepared immediately.

Edmonton, Alta.

The Duggan Building Investment Company, 211 McLeod Building, propose to build an apartment block at an approximate cost of $25,000, and plans are being prepared by W. D. Cromarty, University of Alberta. Brick construction.

Elmira, Ont.

Plans are being prepared for a residence to be built on Centre Street for St. Paul's Lutheran Church. Brick construction. Estimated cost, $3,000. Secretary, G. Klinck.

Hamilton, Ont.

J. W. McKim, 95 Spadina Avenue, has had plans prepared for two residences, estimated to cost $3,500 each. Brick and stone construction.

E. F. Long, 405 Dundurn Street South, is about to start work on four cottages, estimated to cost $1,000 each. Brick construction.

Montreal, Que.

Jean Brunette, Cote St. Luc Road, has commenced the erection of eight flats, estimated to cost $32,000.

Work has been started by G. E. Blackwell, 4184 St. Catherine Street W., on the erection of two flats, estimated to cost $10,000.

Norwich, Ont.

William Corlett, Main Street, is about to start work on a residence, estimated to cost $3,500. Brick construction.

Ottawa, Ont.

T. J. Somerville, 28 Waverley Street, has commenced the erection of a double residence on Bronson Street, estimated to cost $7,000. Brick veneer construction.

Port Colborne, Ont.

Plans of a residence to be built for Julius Knoll, Humberstone, are being prepared by C. M. Borter, Main Street, Niagara Falls South. Estimated cost, $3,000.

Port Hope, Ont.

Ellis & Ellis, Manning Chambers, Toronto, have prepared revised plans of a residence for J. A. Hume, and tenders are now being received by the owner. Steel, stone and brick construction. Approximate cost, $10,000.

Quebec, Que.

Work on the erection of a residence on Hermine Street has been started by P. Blouin, St. Jean Street. Frame and brick construction. Estimated cost, $3,000.

Stratford, Ont.

J. S. Russel, 6 Downie Street, has prepared plans of a residence for George Kalbfleish, Erie and St. Patrick Streets. Brick and St. Marys stone construction. Approximate cost, $7,000.

Strathroy, Ont.

E. Morrow contemplates the erection of a residence, and will prepare plans. Approximate cost, $3,000.

Tavistock, Ont.

Tenders on the erection of a Parsonage for the Evangelical Church will be received until July 4th. Pastor, A. D. Gischler. Brick construction.

Toronto, Ont.

E. J. Zavitz, 20 Lowther Avenue, contemplates the erection of a residence, and plans are being prepared by Williams, Akitt & Ure, 116 Westmount Avenue. Tenders will be called shortly. Brick construction. Approximate cost, $5,000.

F. W. Hill, 55 Woolfrey Avenue, is receiving tenders on excavation required in connection with the duplex residence which he proposes to build on Hamilton Street. Brick construction. Estimated cost, $3,000.

G. W. Dale, 12 Butternut Street, has commenced the erection of a residence and will let the smaller trades. Estimated cost, $3,000. Brick construction.

Plans have been prepared by P. H. Finney, 79 Adelaide Street E., for a residence to be built on Caroline Avenue by M. C. Charters. Brick construction. Estimated cost, $3,200.

Work has been started on the erection of a pair of residences on Blackthorne Street for Miss P. Montgomery, 326 Gladstone Avenue. Brick construction. Approximate cost, $3,000.

W. C. Charters, 110 Caroline Avenue, is receiving tenders on brick work and excavation required in the erection of a residence on Caroline Avenue. Architect, P. Finney, 79 Adelaide Street E. Estimated cost, $3,200.

J. W. Butchart, 1 St. Ives Avenue, has commenced the erection of a residence, estimated to cost $6,000. Brick and stucco construction.

A. W. Clendennan & Son, 200 Brunswick Avenue, propose to build a pair of residences on Euclid Avenue, at an approximate cost of $5,000, and plans have been prepared. Smaller trades will be let. Brick construction.

Zurich, Ont.

F. C. Kalbfleisch is considering the erection of a residence, and will prepare plans immediately. Approximate cost, $3,000.

CONTRACTS AWARDED

Bedford, N.S.

The general, masonry, carpentry, steel, roofing and plastering contracts for the erection of a residence for A. Cobb, Tramway Building, Halifax, have been awarded to Byron Schafelbury, painting to F. McCready, heating to Longard Brothers, 213 Hollis Street, Halifax, plumbing to F. Delancy, Wolfville, and electrical work to F. Maling, Waverley. Frame construction. Approximate cost, $10,000.

Charlottetown, P.E.I.

The general contract for the erection of a residence for Samuel Kennedy, 1 School Street, has been awarded to A.

McDonald, Brockfield, P.E.I. Frame construction. Estimated cost, $4,000.

Halifax, N.S.

The Eastern Investment Corporation, Cragg Building, have let the contracts for heating in connection with the various residences which they are building to Longard Brothers, 213 Hollis Street, plumbing to W. J. Craig, 316 Upper Water Street, and electrical work to John Starr & Company, Granville Street.

London, Ont.

The general contract for the erection of a residence for W. Bossince, 383 Hale Street, has been awarded to T. Leah, 1027 Dundas Street. Brick veneer construction. Estimated cost, $3,200.

Montreal, Que.

In connection with the residence which is being built for Beaupre & Fils, 655 St. Paul Street North, the painting contract has been let to W. D. Rufiance, 91 Rose de Lima Street.

The general contract for alterations to a residence for Russell Cowans, 282 Stanley Street, has been awarded to Laird Paton & Son, 485 St. James Street. Architect, K. G. Rae, 59 Beaver Hall Hill. Approximate cost, $7,000.

The general contract for the erection of six flats for George St. Germain has been let to M. Waxman, 1281 St. Urbain Street. Tenders on smaller trades are being received by the general contractor. Estimated cost, $8,000.

Ottawa, Ont.

The contract for heating and plumbing required in the erection of apartments on Laurier Avenue for James Neville has been let to A. Gauthier & Company, 207 Dalhousie Street, and electrical work to C. Presby, 138 Irving Avenue.

In connection with the residence being built by W. H. Lee, 36 Barton St., the contract for plastering has been let to Bowman & Sons, 239 Florence Street, painting to A. Wilson, 118 Second Street, heating and plumbing to J. T. Blyth, Frank Street, and electrical work to E. Headley, 645 Echo Street.

The following contracts have been let by T. J. Somerville, 28 Waverley Street, in connection with the residence which he is building:—roofing, J. Welsh, Waverley Street; heating, J. Cameron, 488 Lewis Street; plumbing, Thomas Watters, 288 Booth Street; electrical work, C. Presby, 138 Irving Avenue.

In connection with the residence in course of erection for C. A. Bowman, 16 Monk Street, the contract for masonry has been let to Alexander McAllister, 15 Gilmour Street. Tenders are being received on the smaller trades.

In connection with the apartments which are being built on Laurier Avenue for J. M. Ross, 49 Metcalfe Street, the contract for masonry has been awarded to Beattie & Davidson, Renfrew Avenue, and carpentry and roofing to the general contractors.

Peterboro, Ont.

The general contract for the erection of apartments for W. H. Hill, Sun Life Building, has been awarded to Ephgrave & Barrett, 571 Gilmour Street. Approximate cost, $6,000. Architects, Bond & Smith, Wilton Avenue, Toronto.

Quebec, Que.

The general contract for converting a store into four residences for E. Minguy, 29 Berthelot Street, has been awarded to A. Legare. Frame and brick construction. Approximate cost, $3,000.

The general contract for the erection of a residence for Delle Robitaille, 59½ Scott Street, has been let to V. Talbot, 92 Morin Street. Frame and brick construction. Estimated cost, $4,000.

Power Plants, Electricity and Telephones

Ottawa, Ont.

Tenders will be received until 4 p.m., July 3rd, by R. C. Desrochers, Department of Public Works, Ottawa, for the supply of quantities of galvanized iron telegraph wire, to be delivered at Montreal, Kamloops, B. C., and Vancouver, B. C. Specifications at office of MacLean Daily Reports, Limited, 25 Charlotte Street, Toronto.

Quebec, Que.

The Quebec Exhibition Commission, City Hall, will shortly call for tenders on the installation of a lighting system at the Exhibition Grounds. Approximate cost, $11,000.

Saskatchewan Province.

The Neelby Rural Telephone Company have been authorized to borrow $3,200 for the construction of their proposed system. Secretary, J. E. Lewis, Kipling.

CONTRACTS AWARDED

Orillia, Ont.

The Town Council have awarded the contract for supply of equipment for the Swift Rapids Power Plant to the Canadian General Electric Company, 212 King Street West, Toronto. Installation will consist of either two unit of 3,000 h.p., at $68,000, or 3 unit of 5,400 h.p. at $81,000.

Miscellaneous

London, Ont.

The London Concrete Machinery Company have been awarded contracts for the supply of machinery to the following firms:—F. Smithson, Leamington, one paving mixer; G. B. Mitchell, Shawinigan Falls, Que., one paving mixer; Corporation of Manvers, Ont., one batch mixer; J. B. Dore & Fils, LaPrairie, Que., one batch mixer; Somerville & Dilworth, Welland, one batch mixer; John Evans & Son, Hamilton, one batch mixer; Jinchereau & Lalonde, Quebec, one batch mixer; Milton Brown, Wheatley, Ont., one batch mixer; North Shore Power Company, St. Cassimir, Que., one batch mixer; Town of Pointe Claire, Que., one batch mixer; Jedd Scott, Sweetsburg, Que., one concrete mixer.

Late News Items

Alberta Province

The Department of Agriculture, Edmonton, propose to establish demonstration farms at Camrose, Grand Prairie and Vegreville. Approximate cost, $25,000 each. Superintendent, S. G. Carlyle, Parliament Buildings, Edmonton.

Campbellton, N.B.

Plans of a block of stores and apartments to be built for J. A. Belanger have been prepared by Albert Sinsesnes, Architect, Moncton, and tenders will be called immediately. Approximate cost, $8,000.

Montreal, Que.

The general contract for the erection of a Church and Presbytery for St. Jean Berchmans, 2619 Cartier Street, has been awarded to Thomas Belanger, Valleyfield, Que. Stone construction, interior finish of Caen stone. Approximate cost, $200,000. Architects, Gauthier & Daoust, 180 St. James Street.

Oshawa, Ont.

Tenders on the erection of a residence for F. Finnigan will be received until June 24th. Architects, Ellis & Ellis, Manning Chambers, Toronto. Brick and stone construction.

Ottawa, Ont.

The general contract for the erection of an addition to an office building on Sparks Street for C. J. Booth, Booth St., has been let to Norcross Brothers, Booth Building, Rideau Street. Approximate cost, $50,000.

The City Council have awarded the general contract for the construction of sun parlors to A. E. Farley, Banque Nationale Building, Rideau Street, at $9,473. Brick and stucco construction.

St. Maurice River, Que.

The St. Maurice Construction Company have awarded a contract to M. Beatty & Sons, Ltd., Welland, for the supply of an 8 x 12 triple drum hoisting engine with boom swinger, and one 37 h.p. double drum electric hoist for use on the construction of the St. Maurice River Dam near Sanmaur, Que.

Toronto, Ont.

The Board of Control will receive tenders until July 4th for the supply of one 3 h.p. motor and one 20-inch square base self feed vertical drill chuck and shafting. Plans at office of the Fire Department, Adelaide Street West.

Tenders are now being received by Eden Smith & Sons, Architects, 33 Scott Street, on the erection of a Church for the Beulah Hall Congregation. Brick, steel and stone construction. Approximate cost, $25,000.

The contract for masonry and stone work required in alterations to a residence for F. Goldberg, care of Langley & Howland, Architects, 112 King Street West, has been let to C. Wood & Sons, 613 Manning Avenue. Approximate cost of work, $7,000.

Transcont, Man.

Tenders will be received until July 4th by R. C. Desrochers, Secretary, Department of Public Works, Ottawa, for construction of reinforced concrete foundations on piles, required in the erection of an elevator. Plans and specifications at offices of the Chief Engineer, Department, Ottawa; Chief Engineer, Moncton; General Superintendent, Winnipeg; Resident Engineer, Fort William, and J. S. Metcalf Company, Ltd., Montreal.

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Principal Contents

Distant Fields Look Green

There is very convincing evidence to show that the Canadian people as a whole are firm advocates of the old adage, "No prophet is respected in his own country." At any rate they practice this principle persistently, humiliating themselves and their own prophets before the prophets of other nations and, what is even more to the point in this commercial age, paying out good gold for a product which is obtainable in the home market of a quality, as has been repeatedly shown, in no way inferior to the foreign article. Why do we do it?

This is an age of advertising. The manufactured product that is not advertised is simply not used. So with a man. Canadian professional men, however, are not advertisers, and especially does this apply to engineers, who, almost without exception, are modest, retiring, and diffident of extolling their own virtues before the general public. This does not apply in the same degree to engineers of other countries and especially to those of that country with which we come most frequently into competition.

* * *

The local professional man in every walk of life, too, labors under the disadvantage of living down every little mistake he has made. We leave our old doctor because he has made a slight error in judgment and call in a new one of whom we know nothing, and who, likely enough, has just been dismissed by our neighbor for a more serious matter. So with engineers. We know all the mistakes our home engineers have made. They have been talked about in the daily papers, magnified by ignorance and prejudice, reiterated in season and out, until we lack the moral courage to employ anyone in the public blacklist, even if we ourselves have not lost faith in them. And so along comes an outside engineer, headquarters in New York or Chicago; we've never heard anything against him—because we've never heard anything of him before; but he comes highly recommended—by his friends—and the native engineer is out of the running. No search is made of the foreigner's credentials, no list is sought of his mistakes and failures—he's taken at face value—without question. The foreign fields look green, chiefly because they are far away.

* * *

This pernicious habit of Canadian organizations of various sorts would be humiliating, even if it were necessary, but it is rendered many times more so by the fact that we have as good men right here at home as may be found anywhere in the whole world. Their one weakness may be that they lack the wider experience of some of the outsiders, but what they lose in this way is more than made up by a closer knowledge of local conditions, a keener appreciation of local requirements, and a greater pride in local work. One has not to seek far to locate instances of failure of foreign engineers to make good, owing to lack of interest in the work—inspection is scant and infrequent, the responsibilities are given over to underlings who do not measure up to requirements, local conditions and requirements are miscalculated. Then, too, there is frequently a suspicion of a sort of supercilious attitude towards the little Canadian bits of work, such as a $15,000,000 aqueduct, which leads the engineer to take a chance. Sometimes he, too, makes a miss—all of which the Canadian consumer pays for in gold.

* * *

The amount of work, building and construction of every sort at present under way in Canada and being architected or engineered by other than Canadians, is simply tremendous. Either the authorities who pass over the claims of home talent and employ foreigners are wrong or our local men are incompetent. We have no hesitation in urging that there is no trace of truth in the latter alternative. It follows, then, that the blame must be placed with those in authority who employ the foreign architects and engineers—thus laying themselves open to charges of ignorance of the facts, disloyalty to their country and fellow-citizens, and entire lack of appreciation of the value of building up our reputation as a producer of men quite as much as of manufactured products.

Where is the remedy? It probably depends chiefly on the sound common sense of our municipal and other authorities, but surely the engineer himself can do something to assert his rights. What seems to be the most urgent need is that those who buy "service" should become seized of the fact that this product is "made in Canada," and that it stands ready to compete with any similar product made anywhere else. Our professional men, in this sense, then, are manufacturers, and, as such, are surely justified in much more aggressive publicity. Canada has the resources —must we admit we have not got the men to develop them?

Engineers and Architects

The activities of the architect and the structural engineer are related in many respects. In large modern buildings there is a tendency to consider not only the design from a purely engineering standpoint, but also to regard its architectural effects and its relation in a general scheme of city planning and improvements. The same applies to bridge construction, where the bare and ugly structures are being abandoned for the more ornamental and more graceful designs, but quite as correct from every engineering standpoint. This has called forth from the structural engineer his best efforts to cope with the problems of ornamental and architectural art. Engineers as a whole realize their lack of knowledge of the rudiments of architectural design and this has meant the cooperation of architects and engineers in the planning of these ornamental structures. This has a disadvantage, possibly, in that it creates a tendency for each to unduly emphasize his own share in the work and real co-operation is often lacking. There is a call for a person combining the abilities of both architect and engineer, and by slight readjustment, engineering schools should be able to supply this lack. Heretofore, they have not, as a rule, striven to sufficiently broaden their courses, but by the exercise of judicious care in the elimination of old and substitution of new subjects, there is here an opportunity for giving engineering students such an insight into the fundamentals of art and architectural design as will fit them for such work of this nature as they will come in contact with.

Waterbound Macadam Suitable for Heavy Traffic

That waterbound macadam, if properly surfaced—and this can be done economically—will stand up well under heavy motor traffic is illustrated by experience in the Bronx district of New York city, which maintains 1,800,000 square yards of this pavement at a cost as low as 2 3/5 cents per square yard in one heavy traffic street and 3 1/5 cents per square yard in other streets. The method of maintenance is described in a current issue of the Engineering Record:—

The most striking example is the Grand Concourse and Boulevard. This pavement, which is 4½ miles long, has two 35-ft. roadways and contains 192,000 square yards of surface. According to an informal count, it has carried as many as 1,200 vehicles in an hour. It is a main driveway, leading to the parkways and suburban counties to the north, and carries regularly a heavy, and, at times, high speed traffic. Heavy trucks frequent it. Though the proportion of this class of traffic is not large as compared to other streets in the Bronx, it does amount to more than the average hard-surfaced country road has to carry.

The original surface treatment of the Concourse consisted of a ¼-inch thickness of Tarvia A and grit. The tar treatment was applied hot in the proportion of 1/3 gallon to the square yard by a squegee, though the highway officials state that if they had to do it over again they would use a pressure distributor. The cost of the first application was 8 cents per square yard, due to the fact that it was thoroughly cleaned and the dust film entirely removed before the bituminous material was applied. The extreme thoroughness of the cleaning as considered justified in order to secure a satisfactory bond between the metal of the road and the bituminous surface.

Every spring a gang goes over the roadway and using tar, makes whatever patches may be required. When the warm weather comes a paint coat of Tarvia B and grit is applied. This is the only maintenance on the road throughout the year. The aim is to keep the top surface thin.

The maintenance on other waterbound streets in the borough is similar to that on the Concourse. Some of them do not require repairs annually, but are sometimes allowed to go over until the next spring. Those on a grade appear to require less repair than those under similar traffic on level stretches. The quantity of bituminous material applied varies from 1/6 to ¼ of a gallon per square yard, according as the appearance of the road indicates the need of a greater or less quantity.

Million Dollar Sugar Factory

The sugar factory now being constructed at Chatham, Ont., for the Dominion Sugar Company, will be one of that city's largest and finest industries. It will cost over one million dollars and will include eight buildings of fireproof construction, brick, steel, and concrete being the materials used. The site will cover some 64 acres of land. At the present time there are considerably over 200 men employed in the construction, which will require the use of approximately three million brick, 1,200 tons of constructional steel, and 10,000 cubic yards of concrete, and there will also be laid about ten miles of piping. The large smoke stack of the factory, 175 feet high, has been completed, and the steel frame work of the main building is now nearly finished. This building will be 5 storeys high, 320 feet by 140 feet, and when completed, will handle 1,500 tons of sugar beets daily. Other buildings will be the beet sheds, 456 feet x 300 feet; the raw sugar warehouse, 300 feet x 70 feet; the sugar warehouse, 200 feet x 140 feet, and the pulp drier and warehouse, 142 feet x 152 feet, which will have a capacity for drying between 90 and 100 tons per day. The equipment of the factory will be the most modern in every respect, and waste will be practically eliminated. For this purpose a barium will be erected, one of the most important additions to modern sugar plants. This is for the further treatment of the material which passes through the main building, which was formerly discarded as waste, but which can now be turned into sugar by this new process. There will also be a machine shop for making repairs to the factory equipment, and a boiler house, 175 feet x 50 feet, which will contain 12 large boilers with a 4,000 h.p. capacity. In connection with the shipping facilities, 10 railway spurs will run into the plant, and soundings have been taken for the construction of a dock along the water front, which will be about 650 feet long. There will be a storage capacity in the yards and flumes of 50,000 tons.

Signs with which country merchants adorn bridges on rural roads in attempts at advertising, are under the ban of the state highway commission of Minnesota. State aid will be withheld from all counties failing to cause removal of signs.

Relation between Engineers and Contractors

The Successful Contractor of Today has Technical as well as Practical Knowledge — Some Suggestions on the Wording of Agreements

By J. W Rollins *

THE engineer and contractor of the present day are both technical men— the one designing the work and then superintending its construction; the other working out the best method for doing the work and then carrying out the actual construction under the direction of the engineer.

This relation has materially changed in the last few years owing to the great development in modern engineering. In the old days when the work was done mainly by hand labor the engineer was "boss" in many ways, and the successful contractor was the one who could drive his men to the limit, but who had no technical knowledge and in many cases no education, but was guided by that greatest of all gifts, "common sense." He looked up to the engineer as his superior and expected from him such instruction and direction as was necessary to keep him out of trouble.

To-day, however, the situation is entirely changed, and the contractor is often obliged to have more technical knowledge in order to execute work than the engineer who designs it.

It is not a difficult proposition for an engineer to draw a plan showing a foundation for a bridge in water 100 feet deep, possibly in a swift current and in the midst of navigation; or to show a subway 50 feet below heavy buildings in a crowded thoroughfare, under the surface of which may be an electric conduit of 20,000 or 30,000 volts, large water mains under 200 pounds pressure, steam pipes with 500 pounds of live steam, added to sewers, telephone and telegraph lines without number and possibly electric conduits for street car traffic; but to construct such work successfully requires a contractor with great technical skill and knowledge, a man with great resources and strong nerves to meet all the troubles which may arise.

Not Size So Much as Skill

The writer heard Colonel Goethals, of Panama, make this statement: "The people think the Panama Canal is a great engineering feat, but it isn't a particularly great work of that kind, but rather a job of handling a great amount of material; and as an engineering proposition the Panama Canal does not compare with the work done on the New York subways."

When the engineer gives out contracts for work of this kind he should have confidence in the contractors who will do the work; and in turn, the contractors should have full confidence in the engineer. That is, to get the best results there must be the heartiest co-operation between the man planning the work and the man doing it.

The medium between the contractor and the engineer is of course the contract and specification, and to these matters I would ask your particular attention.

A contract has been defined as "a meeting of the minds of the contracting parties," and with this one definition in mind, I think the engineers and contractors could easily settle their disputes, if they could keep the lawyers out of the case. But they can not, and the result is that most engineering contracts have many clauses which are most unjust to the contractors, who, by signing them, give up almost their "birthright."

That a contract in its terms should comply with the definition before given, "a meeting of the minds of the contracting parties," its terms should be so plain and explicit— as free as possible from legal verbage— that any contractor of reasonable intelligence should understand what he is agreeing to do, when he signs the contract.

It should be assumed that when a contract has been awarded, the contractor expects to do the work called for in accord with the terms of the contract and specifications, and to make a profit on his work; that the engineer also expects to have his work done as he has specified, and if so done is willing to have the contractor make his profit. That is, he will do justice to his clients or employers by getting the work done well, and to the contractor in seeing that he is paid justly for what he has done.

The lawyers are responsible for some of the objectionable clauses in contracts, particularly the "blanket" clauses, so called, which hold the contractor responsible for everything that might happen, whether through his fault or negligence or through the fault or negligence of other parties.

Meaningless Contracts

There are often many terms and conditions in a contract, of which neither party knows the meaning, and often the lawyers who put in all the blind, blanket clauses make them so blind that their true meaning has to be settled by the courts.

Here is one of those legal clauses which the writer is certain never originated in the brain of an engineer:

"The said contractors hereby declare and agree that they shall be accountable for the full performance of this contract, and by signing hereof admit that the said plans, elevations, sections, specifications and parts before referred to are sufficient for their intended purpose of doing the said work, and that the work can be successfully executed in accordance therewith, without any additional or extra work other than that set forth thereby or necessarily inferred to be done from the general nature and tendency of the plans, drawings and specifications aforesaid, upon a fair and liberal construction thereof."

This apparently innocent clause which at the time was looked upon as one of a lawyer's ideas of a proper contract and was not expected to be understood by the contractors, cost us $10,000, and a railroad company an equal amount. We agreed to build the masonry for two abutments and a pier for a railroad bridge across a river. The plans showed the two abutments directly behind the old ones with a clearance of about two feet at the foundation lines. The abutments were 30 feet high and when the excavation got down to the footings it developed that the old masonry projected into the line of the new work, so that a cofferdam could not be driven to get the new foundation in. It so happened that the bridge was in a mill pond, so that by drawing the water off on Sundays we finally got the bottom in.

* President of Holbrook, Cabot & Rollins Corporation, Engineers and Contractors, Boston, before the Engineers' Society of Western Pennsylvania

We also got into trouble with the pier, which was on piles with concrete deposited under water for a foundation. The piles were driven and the concrete deposited, and after a week or so an examination of this concrete showed it had not "set." We waited another week, then a month, and finally tried to pump the cofferdam out, with the result that the bottom "blew up," showing the concrete worthless.

Tests were made of the cement—I think it was "Lehigh," and it proved to be all right—but in making tests using the river water the samples would simply "slump," and seven different brands showed the same result. Tests of the water showed it to be polluted by mills above the bridge so that the cement was ruined.

We had to drive a 6-inch dam under the bridge girders at an enormous expense, pump the dam out, deposit the concrete in the dry, and then build the pier.

Meanwhile we were discussing with vigor the matter with the engineers—finally at the completion of the work making a claim for extra pay on account of the conditions developed during construction.

Guaranteeing Work

Our attorneys, however, called our attention to the clause in the contract above read, whereby we had practically "guaranteed" that the work could be done according to plans and that we would not make any legal claims for variations.

The railroad people were fair in the matter and paid half the loss, which we were glad to get in face of the adverse legal opinion given us by our own counsel. But such a clause, in the opinion of the writer, is an absolutely unjust one.

There are other clauses and conditions for which, in the opinion of the writer, the engineer is responsible, and which completely nullify the drawings and general specifications and make absolutely indefinite the amount of work to be done.

For instance:—

"Excavations shall be made of dimensions indicated upon plans, where dimensions are given, **or as otherwise directed.**"

"Piles shall not be driven below elevation 102 and shall be cut off at these levels **unless otherwise directed.**"

Also the clause which allows the engineer to make changes in the line, grade, plan, form, dimensions or materials of the work, with no allowance made for extra payment, when conditions vary.

Anyone can readily see what abuse an engineer could make with these clauses where the contract might be for deep water work, as was the contract from which these were taken; thereby compelling the contractor to go to any depth inside cofferdams with his excavation and pile work.

Disclaims All Responsibility

Another clause, and one which is also general, disclaims all responsibility of information furnished, and in some cases of quantities of work to be done.

Inasmuch as the Supreme Court of the United States has held that borings shown on plans must be taken as the basis of the contract for such items as are covered by them, it would seem that this decision would be broad enough to cover all information given.

And why shouldn't information given be held as the basis of the contract. The engineer spends months in making plans and estimates and getting information upon which to base them. This information is, in the judgment of the engineer, correct, and on his part is the basis of the contract, and on this information the minds of the contracting parties "meet."' It is an impracticability for a contractor to spend the time and money to investigate conditions of a contract as thoroughly as the engineer does, and he doesn't do it, although the contract says he must from his own knowledge make his bid.

So when conditions change, why should not the conditions be met, in a man to man fashion, and paid for in full justice to both parties. This is a vicious clause, one which causes much trouble and which should be eliminated from all contracts.

As to the matter of guaranteeing quantities: This is often a difficult matter, for unless investigations are very complete it is almost impossible to make even approximate estimates.

It generally does not hurt a contractor to have quantities increased, but may cause trouble to have them materially decreased, for this reason: On some jobs there is a large overhead, general and plant expense, and this expense in an itemized bid must be divided up amongst the items, and we generally try to add this expense to the items which are fixed or may be increased, but if some of these items are decreased these general expenses will not get paid for.

The writer is of the opinion that where quantities are given, even as "approximate," the courts have held that they must not vary more than 20 per cent. either way, and if they exceed this variation may be subject to additional payment if this variation causes loss to the contractor.

Here is another clause:—

"The Directors reserve the right to suspend the whole or any part of the work herein contracted to be done, if they shall deem it for the interest of the Commonwealth so to do, without compensation to the contractor for such suspension, other than extending the time for completing the work as much as it may have been delayed by such suspension."

Two or three years ago we took a contract to build a railroad in New England in an inaccessible country, and spent $300,000 in plant, equipment and in getting it onto the line of work. About this time came the crash in New England railroads, and we expected to be ordered to stop work. We were not, however, although there was a "stop clause" in our contract; and if trouble had come, where do you think we would have "gotten off?"

Doing Impossibilities

There is always much discussion as to clauses which for their execution call for what practically is an impossibility, and as to whether they can be enforced, or compel the contractor to pay the penalty. A recent opinion of the court on the question of executing an impossibility:—

"There can be no question that a party may, by an absolute contract, bind himself to perform things which subsequently become impossible, where the event which caused the impossibility might have been anticipated and guarded against in the contract, or where the impossibility arises from the act of default of the promisor. . . . But where the event is of such a character that it cannot be reasonably supposed to have been in the contemplation of the contracting parties, when the contract was made, they will not be held bound by general words, which though large enough to include, were not used with reference to the possibility of the particular emergency which afterwards happens."

We have had some sad experiences with this impossibility clause. On a certain contract for an intake for an electric power development, we had to build a sea wall, and the plans showed 6-inch hard pine sheeting driven to a depth of 20 feet below mean low water. The specifications said, "sheet piling should be driven as shown on plan," and no borings were taken and no information given as to the material through which the material was to be driven, although the general character of the soil was sand. This line of sheeting was to act as a permanent bulkhead, and would be of no value if not driven without crippling or deforming the timber.

Before we got ready to begin our work, other construction immediately adjoining us was undertaken by driving similar sheeting for a deep trench, though through no depth of soil, with no success, the timber being badly crippled and broken. We called these conditions to the attention of the engineer, but with no results, so we began our work, but could not drive the sheeting, though we tried every contrivance known, with heavy water jets and steam hammers. Finally the engineer admitted we could not drive the sheeting satisfactorily and the plan was changed by dredging out most of the sand and gravel, driving the sheeting and refilling the dredged area.

Before this was done, however, we made the "impossibility" plea, but were told that the company's lawyers wouldn't listen to it, that we had agreed to do the work according to the plans, and that if necessary to get the sheeting down to grade we should bore holes in the gravel or rock, if there, and stick the timber in these holes.

Another condition common to contracts, which we object to, is the one under which the engineer can design a structure and give the exact instructions under which the work is done, or require the approval of the engineer to a design submitted by the contractor, and yet disclaim all responsibility for the results. The principles in law on this matter have been pretty well settled by the courts. A decision of the Supreme Court of the United States has settled the fact that an engineer designing a structure and directing in full the construction, must assume the responsibility for its fulfilment of its functions.

The Engineer's Responsibility

For instance, although a contract states that a contractor must guarantee a waterproofing job, if the engineer prescribes the method of construction and supervises the work as done, this guarantee cannot be enforced. A notable instance of this was developed in the construction of the Charlestown Navy Yard dry dock at Boston. The construction of this dry dock required a cofferdam of great strength, although of not very great length; the excavation going down to 40 feet or more below low water. The contractors for the work were men skilled in water construction, and submitted a plan of cofferdam to the engineer in charge of the work; and this plan was objected to as lacking in strength, and the plan returned to the contractors. A second plan submitted by the contractors was similar to the first, but showed great detail; and this plan also was rejected by the engineer and returned to the contractors. The contractors afterwards submitted several other tentative plans for the construction of a cofferdam; but they were disapproved and rejected by the engineer. Subsequently the engineer suggested a different plan of his own for the cofferdam, the details of which were worked out by the contractors under the advice and approval of the engineer; and the cofferdam was finally constructed by the contractors according to the plan proposed, under the direction and approval of the government engineer in charge. The contractors objected to the plan as proposed by the engineer, but never made any formal protest as to its use. During its construction three breaks occurred, the first two of which occurred because of defects in the plan suggested and directed to be used by the engineer and these defects were such as the exercise of ordinary care and skill in the construction of cofferdams would have foreseen; the third break was owing to causes which could not have been foreseen by either the contractors or the government inspectors in charge. The repairing of these first two breaks cost the contractors the sum of $27,821.08. The several breaks in the cofferdam compelled the contractors to keep up the pumping plant and perform pumping in the excavation of the dry dock longer than they otherwise would have done. The first two breaks mentioned compelled the continuance of the pumping plan for 34 days longer than would have been necessary had these breaks not occurred, and the cost of said pumping was $37.20 per day, making $1,264.80 for 34 days. The specifications which were made a part of the contract provided:—

"The works included in the contract will be carried out by the contractors under the inspection and supervision of the civil engineer detailed for the purpose, who will inspect all the materials and workmanship and will have full authority to reject any which, in his opinion, are not in full accordance with the true spirit, intention and meaning of the contract, plans and specifications."

It is true that the contractors by these provisions of the contract agreed to construct the dry dock "under the inspection and supervision" of the government engineer, and "subject to his approval;" but we do not think that they thereby agreed to suffer any and all losses which might occur to them by reason of his mistakes in directing the manner in which the work should be done. We certainly do not think that they agreed to bear losses which might occur by reason of defects in a plan proposed and directed by him to be used, which the exercise of ordinary care and skill should have foreseen.

Numerous cases to the same effect might be cited, and we believe the rule in cases of this character to be that where a contractor constructs a work under a contract which provides that it shall be done under the direction and supervision of an engineer appointed by and under the employ of the owner and loss occurs to such contractor by reason of defects in the plans directed to be followed by such engineer, of a character which ordinary skill would have foreseen, the owner should pay for such loss. Following this rule the loss occasioned by the first two breaks in the cofferdam was allowed to the claimants.

(To be Continued)

Big Western Demand for Cement

The Canada Cement Company has re-opened its large cement manufacturing plant at Exshaw, Alberta, which employs about 3,500 men when working to capacity. It is probable that owing to the increasing demand for the company's product in the West, the Calgary plant will be started up later on. The mill at Exshaw is, however, the best equipped to handle the business, owing to its proximity to the cement rocks. The company has 13 plants in all, six in Ontario, 3 in Quebec, 3 in Alberta, and 1 in Manitoba. New building throughout the West is generally restricted, but the record crop last year brought in a demand from farmers for cement that is said to be the largest ever known.

Planning the Town of Iroquois Falls

An Industrial Centre Without Any of the Usual Objectionable Features—Utilitarian and Aesthetic at the Same Time

THE average industrial town is apparently designed without consideration of the broader principles of the art of town-planning, and, on this account, presents as a rule an unsightly, unsanitary appearance, with an utter absence of any sign of the aesthetic or the beautiful. Such a town is developed entirely through a spirit of commercialism and without regard to the welfare of its inhabitants, and results, without doubt, in their lowered mental and physical standard and their less efficient physical capacity.

Of late, proper industrial town planning has received more and more recognition and there has been a tendency on the part of many industrial concerns to lay out their town-sites with more consideration for the health, culture, refinement and pleasure of their people, by providing more room, easier accessibility, and greater attractiveness. The new town of Iroquois Falls, Ontario, planned by the Abitibi Power and Paper Co., in connection with its huge pulp and paper mills, is an illustration of this. In the case of this town, the officials of the company have striven to get away from the prevailing methods by providing such surroundings and environment as will contribute to the beauty of the town and tend to improve the contentment and happiness of the community.

The method of laying out this new town is described in an article in a recent issue of "Engineering and Contracting" by A. P. Melton, who acted in conjunction with the Abitibi Power and Paper Co. in working out the plan. The article in part follows:—

In planning the town of Iroquois Falls, Ont., Mr. F. H. Anson, president of the Abitibi Power & Paper Co., Limited, and other officials of the company, took up the matter with the writer with as much earnestness and with as much regard for detail and careful selection of site as they did in the construction of their great paper and pulp mills at this place. The mills and town are situated on the Abitibi River some 400 miles north of Toronto and about 150 miles south of James Bay. The mills are abundantly supplied with water power by the falls in the Abitibi River at this point.

An Ideal Situation

The town site is beautifully situated in a right angle bend of the river on a rolling plateau having an elevation of 125 to 150 feet above the river, this plateau being indented at various places by short and deep ravines, with an occasional ravine extending back for a mile or more from the river.

The gridiron system of laying out streets was followed in principal as being the most practical and economical method; however, the topography of the site was such that it was advisable to curve a number of the streets to get economical grades and at the same time utilize the maximum amount of the plateau, resulting in a very graceful layout without departing greatly from the gridiron principle. All business lots were made 25 by 125 feet in size and residence lots were in general 50 feet in width and from 110 feet to 150 feet in length. About 80 acres were laid out in the first plan and provisions were made for future extensions of about 160 acres.

The controlling features of the first plat, which is described and illustrated in this article, are the railroad and the edges of the plateau. A number of rectangular blocks were laid out adjacent to the railroad for business purposes, a small park forming a sort of civic centre and sufficient in size to contain all necessary public buildings was laid out adjacent to the railroad and business district, with the idea that the better class of business buildings will face this park, the bank, theatre and hotel being included in this class. A small park is also provided at the end of the railroad which, with the larger park, furnishes a screen between the residence and business portions of the town. The arrangement of these details will give a very pleasing "First Impression" to passengers alighting from the trains. Another advantage lies in the fact that children would not pass through the business district on their way to school. Locations are suggested for churches which add to the harmony of the layout.

Nine-Acre Playground

The school site shown contains about nine acres and it is intended that the school grounds shall be the public playgrounds and athletic park, for adults as well as children; also it is planned that the school gymnasium, and auditorium, be open to the public at all times when not being used for school work. Part of the school grounds are set aside for children's gardens, the idea being to give the children actual experience in growing such products as may be propagated in that far north climate and at the same time foster an interest in agriculture. The writer could say a great deal about the school plant if space would permit, as this institution takes care of about one-fourth of the population for several months in the year and is worthy of considerable comment. The school grounds as shown on the plat merge into a large park which includes two branches of a deep ravine that form the boundaries of the school grounds proper.

In laying out the streets a drive named Hillcrest Road, was laid out around the edge of the plateau, following as closely as possible a certain elevation, and laying out interior streets to approximate the usual gridiron system, most of them being curved to conform to the general direction of the contour lines, and wherever possible terminating all interior streets in the heads of the various ravines at the edge of the plateau, thereby providing a useful and economical dumping place for dirt excavated out of the streets, and also enabling more ground to be utilized for building purposes. Grades were established so that the sidewalk would be slightly lower than the general property grade to provide proper slope from the house to the sidewalk, the average cut being from 1 to 2 ft. in the paved portion of the street, most of this excavated material being used in filling up the heads of ravines. The same irregularity in grades is practiced as in street lines, the grade lines following as closely as possible the contour of the ground and all changes in grade being connected by means of vertical curves consisting of a change of 1 per cent. in grade for each 20 feet of horizontal distance. It was attempted to keep all grades under 7 per cent., but one of 10 per cent. was established for a short distance.

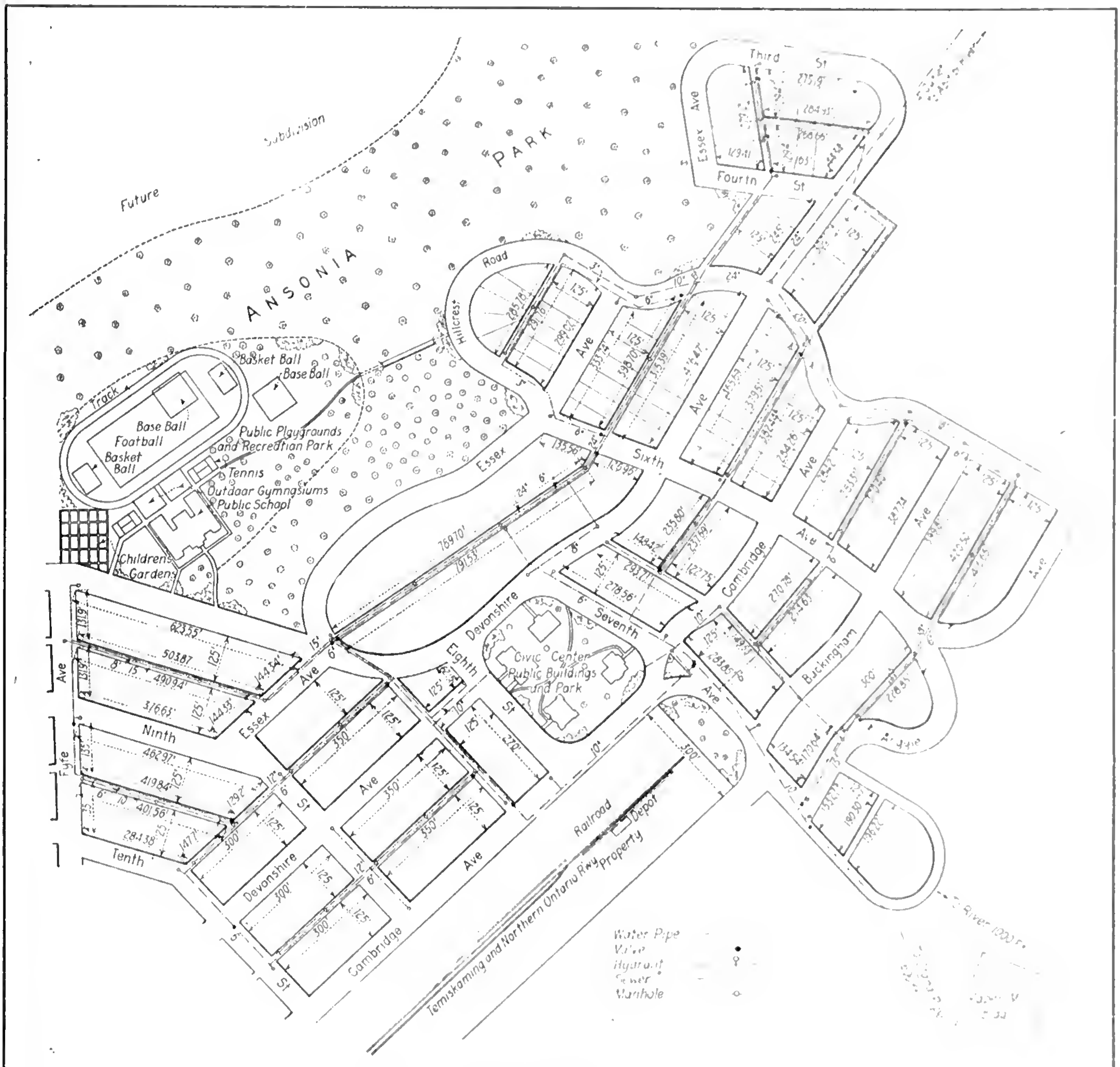
Nothing out of the ordinary was attempted in the way of improvements, all streets being of macadam with combined curb and gutters and 5 ft. cement walks, residence streets having a 22-ft. roadway between curbs, and business streets 36 and 40 ft. Macadam, stone and gravel are obtainable within a short distance, while any other material would have to be shipped 500 miles or more.

Sewers are all collected into one 24-in. outlet which discharges into the river below the town and all have more than ample fall. All sewers are to be constructed of vitrified tile.

The water supply is taken from the Abitibi River above the town and is treated by means of a Norwood Engineering Co. coagulating and pressure filter installation.

All Water Mains Seven Feet Deep

On account of the severe climate, it is necessary to have at least 7 feet cover over all water mains. The water in the river has the characteristic color due to vegetable matter common to all streams in this locality, but being in a virgin forest is polluted in no other manner and is perfectly pure after the filtering process.



Ideal town plan—The industrial site of Iroquois Falls, Ont.

The company furnishes electricity from its hydro electric plant for domestic and street lighting. Sewers, water pipes, and light poles are placed in alleys wherever practicable.

The soil is clay and is heavily timbered with spruce, balsam, tamarack, poplar, and some birch.

The population of the town will probably never exceed 2,500, as not more than 500 operatives will be employed in the mill; however, a much larger force will be employed in the woods, but will make their headquarters elsewhere.

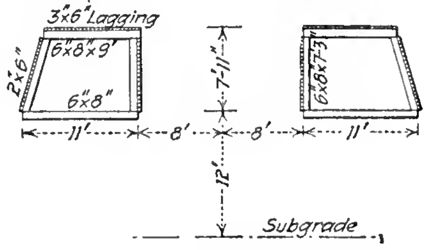


Fig. 1. Two Wall-Plate Drifts

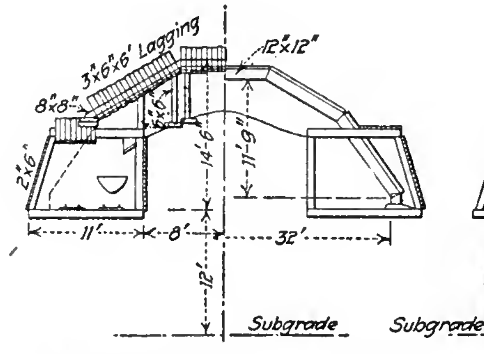


Fig. 2. Stoping Out Between Drifts

Fig. 3. Placing Five-Segment Timbering

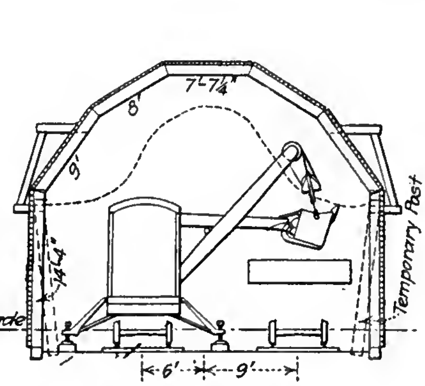


Fig. 4. Excavating Core

Showing features of construction work on Rogers Pass Tunnel of Canadian Pacific Railway Co.

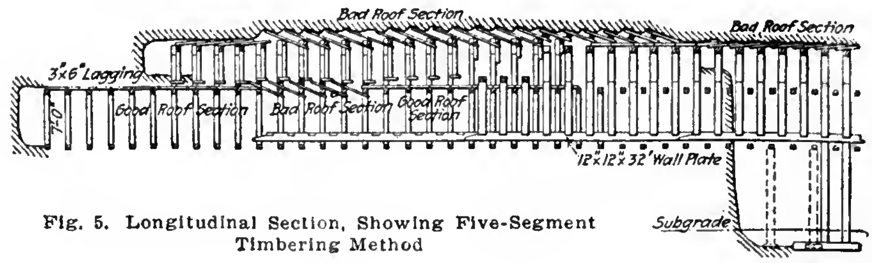


Fig. 5. Longitudinal Section, Showing Five-Segment Timbering Method

Rogers Pass Soft-Ground Work

By J. G. Sullivan*

TUNNELING by such a method as to make the larger part of the excavation yardage accessible for steam-shovel mucking is the feature of the Rogers Pass tunnel work on the Canadian Pacific. This method might not seem well adapted to soft-ground work, but it has been applied with full success in the two portal sections as well as in several soft-rock sections farther in.

At the east end there was 1,300 feet of tunnel through more or less cemented mountain debris. The method followed here was first to drive two wall-plate dirfts (see Fig. 1 herewith), then stope out between these two drifts at various points (Fig. 2) and place five-segment arch timbering (Fig. 3). The core of the cross-section and everything below the wall plate was excavated by steam shovel (Fig. 4), the shovel removing over 66 per cent. of the total excavation in this section.

Practically the same method was followed in several soft spots encountered in solid rock. The tunnel was stoped out to the level of the wall plate and the arch timbers placed.

Seven-Segment Method in Loose Wet Ground at West End

At the west end there was about 400 feet of very heavy ground, consisting of much looser material than at the east end. It contained large boulders and carried considerable water. The method employed here differed from that used at the east end in some important particulars. A seven-segment arch was used, and it was carried directly on posts instead of on a wall plate. To set this timbering five drifts were used. There were two superimposed drifts on either side, clearing a way for the posts, and there was also a crown drift. As soon as the posts were set, the ground between the upper post drift and the crown drift was stoped out and the arch segments set.

This method, of course, was very expensive in the use of timber, but it permitted the steam shovel to excavate the entire core of the tunnel, at this point about 51 per cent. of the total excavation. Except for the desirability of getting the steam shovel into rock as quickly as possible, very much lighter timbering and bracing would have been used. The essential purpose of the whole method was to allow the steam shovel to go through and reach rock as quickly as possible.

One peculiarity about this section, which caused some concern, was the problem of how to support

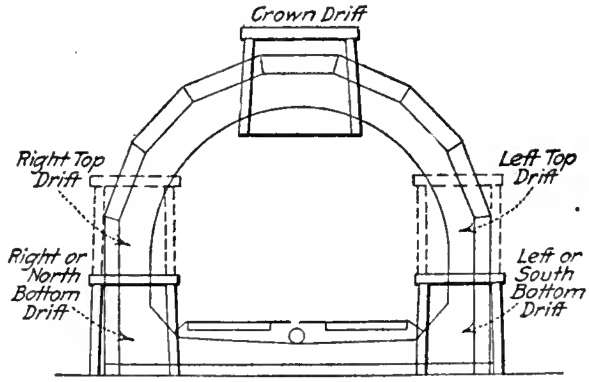


Fig. 6

the roof load until a concrete base could be put in. The top load was so heavy that even 12 x 16-in. timbers set solid would not carry the burden without crushing. These timbers were doubled, two sets of posts as well as two sets of arch timbers being used.

The posts rested on mud sills no wider than the post, and, strange to say, no settlement took place, in

*Chief Engineer, Canadian Pacific Railway, in Engineering News.

spite of the fact that the ground was very soft when disturbed. The ground when worked up by the steam shovel would get so soft that the shovel would have buried itself if not carried on a solid floor of timbers. The explanation is, of course, that when the water was drained off the ground became very hard, and that the roof timbers acted as a perfect arch, carrying the load to the surrounding ground by arch action instead of transmitting it to the posts.

The original intention was to put in a solid floor of concrete, as shown in Fig. 6, but finally only a strut 18 in. wide every 30 feet, was used.

Increasing Building Activity

Lambton Mills Public School

The new public school at Lambton Mills will be a handsome addition to the buildings of that community. The school will have four standard class rooms, teachers' room, principal's room, and play rooms in the basement.

The building will be constructed with Milton rug brick with stone trimmings. The particular feature of the building outside of the exterior artistic effect is the placing of the main corridor on one side of the building rather than in the centre. There will be two separate staircases, one at each end of this corridor. In the interior equipment very little trim will be used, so as to eliminate any lodging places for dust and dirt. The floors and such trim as will be used will be hardwood. The class rooms are all naturally lighted from the east and are also provided with electric light. The Pease heating system of forced ventilation will be installed, also a private sewage system with septic tank. The boiler room will be thoroughly fireproof, and the building will be provided with four exits so that it can be rapidly emptied in case of emergency. The school was designed by Ellis & Ellis, architects, Toronto; the general contract has been awarded to R. Mudghall.

Children's Home, Belleville, Ont.

The illustration herewith shows the architect's sketch of the new Children's Shelter being erected by the Children's Aid Society on Dundas Street East, Belleville. The architects are Ellis & Ellis, Manning Chambers, Toronto. The building is a three-storey and basement brick structure, designed in the Georgian style of architecture. In plan it measures about

Belleville Children's Shelter—Ellis & Ellis, Architects.

54 feet by 48 feet. The exterior of the building is made as plain and free from excess ornamentation as possible and yet of such a character as to make it home-like in appearance, so as to avoid any indication of an institutional type of building. The interior is planned with all the essential requirements of a children's home, with recreation rooms, dormatories, infirmaries, and three large sun rooms.

Messrs. Allen and Harvey, Belleville, are the general contractors, and the estimated cost is about $17,000.

Architect's perspective of Lambton Mills Public School—Ellis & Ellis, Architects.

Roof Materials and Roof Coverings

A Protection and Safeguard to the Building Often Given Only Secondary Consideration—Choice Dependent on Many Factors

THE roof of a structure is as important as any other single part of its make-up. It serves to protect and safeguard the building and its contents from the action of the elements, and so important is this purpose that careful consideration of its design and construction is essential. The roof covering especially, or that part of it which is exposed to the exterior, requires particular care in its choice, for it is upon this that the wind, heat and light have their effect. The object of this article is to endeavor to set forth some of the conditions that most affect the selection of a roofing material and to describe the properties of a few coverings most commonly employed.

The roofing materials in ordinary use have in each case more or less limited applications; that is to say, no one material can serve in every possible type of design. There are a large number of considerations that must be taken into account when a suitable material is desired. Those factors that bear most upon the choice of a roof covering are enumerated and enlarged upon below.

Factors Governing Choice

First, type of building: The type of a building and its purpose obviously influence to a very great extent the design which a roof must have and in this way, the material of which the roof covering must consist. Attention must be paid to the purpose for which a building is intended and the permanence of its construction.

Second, the pitch of a roof: It is extremely important that a roof material be adapted to the pitch of the roof. There is a certain limitation in this regard to the use of all roof coverings. Thus, roofs of slate, tile, unsoldered tin, etc., are used only on sloped roofs, whereas gravel and tar are applicable to flat roofs exclusively. If the pitch and the material are not properly related, leaky roofs are sure to result. The following table gives the desirable slopes that may be safely used with the roofs mentioned:—

Material	Rise of Roof per ft.
Wooden shingles	6 in.
Slates	6 in.
Tiles	4 in. to 7 in.
Corrugated iron	4 in.
Tin plate	1 in.
Concrete	Flat
Tar and gravel	½ in.
Asphalt	½ in.
Ready roofing	1 in.
Asbestos shingles	3 in.

Third, strength and rigidity: All external roof loads, such as due to wind and snow, act primarily on the roof covering, from which they are transmitted to the rafters, trusses and walls. The covering must be of such strength as to carry these loads with a reasonable factor of safety and of such rigidity that excessive deflections will not be caused. The load acting on the roof varies within a wide range, but a roofing material must be chosen for the maximum estimated load. The wind load varies according to the pitch and exposure, and snow depends on the slope and on the climate. Even with steep roofs, where the snow load is negligible, a sleet load, which will cling to a roof of any steepness, must be calculated.

Fourth, durability: A roof must show an ability to wear and to resist abrasion from weather. It is essential that the roof should last as long as possible without repairs.

Fifth, resistance to weather: This is the most essential requirement of a good roof covering. It must withstand the effects of rain and snow, heat, cold and wind. Its construction must be such that no water will remain in the joints, and provision must be made for expansion and contraction.

Sixth, fireproof qualities: The fireproof requirements of a building vary widely with its purpose and location, but it is important that a roof should be fire resistant, to prevent spread of fire from one building to another, as well as for a building's own protection. Many fires are caused by the roof of a building acting as a spreading agent. Many roof materials are entirely unsuited for fireproof or even fire resisting construction, and the question that governs the selection of a suitable covering is the degree of incombustibility desired. The qualities that relate to the fireproofness of a roof are: (a) inflammability; (b) fire retarding properties, that is, its ability to resist spread of fire on the surface, or to afford protection to the roof structure against exposure to high temperature; (c) blanket effect upon fires within the building; (d) danger from flying brands. In considering the fireproof qualities of a roof, its liability to act as a target for lightning must also be conisdered. In ordinary buildings in which there are stair wells or elevator wells, the roof is likely to be severely tested by heat in case of fire and this is the part that is most often neglected.

Seventh, expense: The item of expense enters very considerably into the selection of a roof. The question that often must be carefully considered is the balancing of low first cost with heavy maintenance charges and short life against higher cost with longer service.

Eighth, architectural considerations: This also enters very widely into the choice of a roof, especially in residences or monumental structures where beauty and appearance have a great deal of weight.

Ninth, temperature within a building: Radiation through roofs of certain kinds is a serious problem. A building can often be too hot in summer and too cold in winter through excessive roof conduction. This necessitates insulation of some type. Of a similar nature is insulation against condensation which may cause damage to machines and products as well as annoyance to operators. Condensation also has a material effect upon the deterioration of metal roofs.

Tenth: Location and availability of labor and material, with the consequent effect on cost must be taken into account.

There is a wide range of materials suitable for roof covering. Each has its special field of application and has certain advantages and disadvantages. The most common of these are discussed in the following paragraphs:—

Wood Shingles

The best shingles are those made from cypress, cedar, red wood, white and yellow pine, and spruce, in the order named. Shingles have the advantage of low cost and easy application, but their combustible nature prevents their use in buildings which must be of a fireproof nature. The scarcity of material is increasing the cost of good quality shingles and encouraging substitutes. To increase their durability, they are sometimes creosoted or painted. Paint is said, however, to increase decay by closing the pores and preventing rapid drying after exposure to rain or snow. Wood is also employed in the form of sheathing as a base for other roofing materials.

Slate

A good slate should be hard and tough, should have a metallic ring when struck, and should be easily holed without danger of fracture. Slates are durable and reasonably fireproof, and the range of colors in which they occur can be utilized to produce good architectural effects. They have a tendency to crack and conduct heat and cold rather easily. They are laid on wood or beds of cinder concrete, which holds nails as well as wood.

Clay Tiles

Clay or terra cotta roof tiles are used extensively for roof building. They are fireproof, durable, require no painting and are poor heat conductors. If well made, they are moisture proof, more especially if semi-vitrified or glazed. Both flat and interlocking types are used, the latter being considered to make the most satisfactory roof. Non-waterproof tiles are often used as a base for the addition of waterproofing material. The hollow, so-called book tile, set on tees, is frequently used. The high cost of tile is its chief drawback. An additional expense is entailed on account of the increase in strength which must be made in the supporting frame to carry the heavy dead weight. The variations in color of clay tile lend themselves to the production of architectural effects.

Glass tiles are also made of the same shape and size as clay and are used where skylight space is desirable without breaking the continuity of the roof surface.

Metallic Roofs

Iron or steel possesses may suitable properties for a roof material. Its quality often depends to a large extent on the purity of the metal, and it must be protected to prevent corrosion. The plain undipped sheets require painting for their preservation. Corrugated sheets are very extensively employed for the roofing and siding of mills, sheds, grain elevators, and warehouses. The best grades of corrugated sheets are now made of double-refined, box-annealed, iron or steel. The corrugations are usually made lengthwise of the sheet and are intended to give longitudinal strength and incidently improved appearance. Corrugated sheets can be used without underlying support except the purlins. Their life is increased by galvanizing or coating with zinc, which, on account of its low corrodibility, prevents rapid deterioration. This process increases the weight approximately 2½ oz. per square foot and the cost about 30 per cent. The zinc coating should be applied after corrugating so that the process of stamping will not injure it.

Tin and terne plate are iron or steel sheets dipped in molten tin, or terne, which is a mixture of tin and lead. The heavier the coating, the more valuable the plate, as it is more resistant to corrosion. A tin roof properly put on and properly painted will last from 40 to 50 years, or longer. These roofs require painting, however, every few years, and it has been proven that certain paints, notably those containing graphite and tar, are injurious.

Iron or steel roofs are light, yet sufficiently strong in most cases, are fire resistant, are lightning proof and easily applied. Their lack of durability is a disadvantage, and painting is required at frequent intervals. Heat conduction and condensation are drawbacks, necessitating an insulating layer underneath.

Copper is one of the most durable and lightest of roofing materials, but its expense prohibits its extensive use. It requires efficient insulation to prevent heat radiation.

Lead and zinc roofs have not found favor on this continent.

Concrete

Concrete slabs or tiles of interlocking types, made in the factory and reinforced with metal fabric or mesh, may be laid without sheathing on steel purlins. This type of construction is often only semi-fireproof since the slabs are usually of insufficient thickness to prevent failure of the reinforcing. To make the roof waterproof, an ordinary roofing material is usually laid on top.

Monolithic construction—In this method the covering is made by spreading concrete either on reinforcing supported by forms or on self-supporting expanded metal requiring no forms. The construction can be so made as to keep the thickness down and lessen the dead weight. Concrete roofs are durable and fireproof if the reinforcing is properly protected, and have a considerable strength. Their weight is sometimes objectionable. Since the slabs are thin, heat radiation takes place, and insulation must be used to avoid this and to overcome condensation.

Concrete is also used on roofs as a base for tile, slate, or tar and gravel.

Built-up Roofs

These, as the name indicates, are made from various materials directly on the roof. They usually consist of several layers of saturated felt laid on wood or concrete and coated with tar or asphalt and protected with slag, gravel, or cinders, imbedded in the coating. Both tar and asphalt are subject to adulteration, more especially the latter. Moreover, the use of certain oils for fluxing may cause internal change in asphalt, and in consequence, tar is more dependable besides being cheaper and is more extensively used.

The felts used in built roofs are merely media for holding the pitch in place.

A coating of gravel, slag, or stone is used to keep the pitch in place and to protect it from the elements and to give the covering some fireproof qualities. Tiles are occasionally used.

As the materials melt in the heat of the sun, coverings of this type can be used only on flat roofs.

Ready Roofing

There are innumerable, so called, prepared or ready roofings, which are made by cementing together two or more layers of saturated felt and then coating with some material which may be of either fine or coarse nature. These roofings are put up in rolls or sheets, are easily applied, and require no previous experience in setting up. They make excellent coverings in many cases, especially in roofs where the rise is one inch or more per foot, in which case ordinary gravel would roll off.

Asbestos

Asbestos is sometimes used on roofs in the form of either sheathing or shingles. Asbestos sheathing is corrugated asbestos building-lumber reinforced with sheet steel or woven wire netting. It is applied the same as corrugated iron.

Asbestos roofing shingles are made of asbestos and cement. The advantages claimed are their fireproof qualities, toughness, elasticity, lightness in weight and ease of manipulation, cutting and sawing. Various colors are now on the market. The cost is higher but maintenance is low.

The above description applies to the most commonly used roofings. There are others that are less extensively employed and have more or less uncertain advantages, but those mentioned are the standards used in all modern building construction.

Concrete Foundation Construction

THE modern type of building has introduced new problems in foundation construction. There has, in recent years, been a remarkable development in concrete pier work, as these have turned out to be often the only satisfactory supports for large structures. Many new and ingenious methods are constantly being displayed for their construction, and unquestionably, the work attempted at the present time would have been impossible only a few years ago with the facilities then at hand. From time to time the Contract Record has mentioned instances of concrete pier work, and believing that new methods and ideas are always of interest to contractors and engineers, we give in this article a sketch of the methods used in laying the foundations of the Buffalo General Electric Company's new 100,000 kw. steam generating plant on the Niagara River. This case illustrates particularly well the use of steel cofferdams, composed of sheet steel piling of the well known Lackawanna make. Sheet steel piling of this nature has many practical advantages, which in this instance undoubtedly contributed to the ease with which the piers were sunk. The entire driving force can be concentrated on a single unit of small width, resulting in the penetration of obstacles that would have proved difficult or insurmountable for rigid caissons as usually employed. A great deal of ingenuity was displayed in the methods adopted for handling the piling, excavating and concreting, all of which contributed to the rapidity with which the work was carried on.

The site of the power house is on the bank of the Niagara river near Buffalo. Tests showed a level solid rock 40 feet below the surface with the intervening soil consisting of 9 ft. of soft mud, 28 ft. of water-laden quicksand and 3 ft. of half and half clay and boulders. The requirements of the building and the nature of the soil necessitated foundations to bed rock and so fixed that any movement of the quicksand would not cause distortion.

The plan determined upon called for about 160 concrete piers with diameters varying from three and a half to nine feet. The caisson shells were composed of Lackawanna, 12¾ x ⅜, straight section, interlocking, sheet steel piles, 33 ft. long. The piles for the smaller caissons were curved at the mill to suit the circle required, but the angle allowed by the interlocking joint did away with curving for the larger caissons. These shells when driven remain as permanent sheeting around the piers. About 1,300 tons of piling was required.

Interlocking piles require assembling before being driven, and it was therefore necessary to be able to raise one pile high enough above another so that the interlocking joints would engage. This meant that with the 33 ft. piles, provision must be made for the upper end of the upper pile to be 66 ft. above ground. To allow this, two cableways were constructed about 70 feet high, and when the piles were taken from the trolleys they were picked up one by one by the cableway, and assembled together in the caissons.

To insure a perfectly vertical and circular shell, driven at exactly the correct location, as well as to provide a foundation for the steam hammer, a wooden pile was driven in the centre of each of the positions. In this pile a 12 in. deep, 3 in. diameter hole was bored, a wrought iron hoop driven over the top of the pile to keep it from splitting and a steel pin, 20 in. long was inserted. This pin held in place a circular, horizontal template of the same diameter as the interior of the caisson. For the support of the steam hammer a heavy wooden mast, 42 ft. long, was then set so as to rest on the 3 in. steel pin, and thus extended up 9 or 10 feet above the top of the caisson. This mast was guyed by wire ropes. A second circular template was secured to this mast 17 ft. above the first one. This mast, to which the driving hammer was now attached, was left free to revolve. The steam hammer was supported by a ring that allowed it to slide upon the mast and revolve with it. The feed lines passed through a set of double blocks on the top of the mast to a stationary engine.

In setting the caisson the first steel pile was raised and placed in a vertical position against the templates. A second pile was then raised to the top of the first, the joints interlocked and the pile lowered. This process was continued until the shell was complete. Two piles were always driven at the same time and to a depth of about 3 ft. The hammer was then raised and revolved to the next two piles, which were driven in the same distance. The operation was continued in this way until rock was reached. Twelve masts and five hammers were used at once, the extra number of masts allowing assembling work to be carried on ahead of driving work.

For excavating, a multi-stage, centrifugal pump of 1,500 gallons per minute capacity was installed. Six-inch distributing pipes carried the water close to the caissons. A 6-in. sand jet pump and two water jets were placed vertically on the earth material inside the caisson, the upper end of the supply tube being closed by a valve. The water was turned onto the jet, and as it could escape only through the bottom, the tube settled rapidly by its own weight to a point close to the rock. The valve on the pump was then opened and immediately a stream of sand and water was discharged, having been loosened by the high pressure jets. This method excavated each caisson in about two hours. The boulders and clay just above the rock were broken up and removed and the bottom was carefully washed with jets to insure perfect cleanliness.

The reinforcing steel was then inserted, having ben previously assembled, and the concrete was poured from a travelling mixer (which ran on a railway track laid between the lines of caissons), through an ordinary water-tight tremie pipe, the mouth of which was kept always below the surface of the concrete. After a day or so the water was pumped out and the laitance removed.

The city of Hamilton are distributing a very complete report submitted to the Board of Control and the aldermen of the city by the city engineer, giving an account of the work done in the several departments under his charge. The present population of the city is given as 100,461; acreage, 7,143, and the assessment value, $79,700,752.

Science of Wood Preservation

WOOD is an organic body and as such is subject to decay. As a structural material its advantages in many respects have never been surpassed, but this inherent tendency to decay produces a drawback that is not possessed by metals. This has led in recent years to the industry of wood preservation. Another factor has contributed largely to this—the fact that the forests have been so stripped of those timbers which best resist decay and insects, making them unduly expensive. This has roused the consumer to turn his attention to the available timbers, since the results of many experiments have shown that by proper treatment these can be made to supply his needs practically as well and at a lower cost.

The yellow pines have been largely treated in this way. Lately, gum and beech timbers have been treated extensively in the United States for cross-ties. In Europe, the beech has been one of the cross-tie woods for many years, its value, when properly treated, having been long recognized. European railroads often secure as much as 25 years' service from properly treated beech cross-ties, whereas if untreated they would scarcely last long enough to warrant their use at all. Until recently the oaks and southern pines furnished the majority of ties bought by railroad companies on this continent, but now the advantage of timber treatment is being fully recognized and these more expensive and less plentiful timbers are fast being replaced by the other woods.

Wood is an organic body with an outer layer composed of sap-wood and water, containing cells, in which there is a large amount of organic substances, and with an inner structure called heart-wood usually distinguished from the sap-wood by its dark red color. Heart-wood is filled with gums and resins and contains less water than the sap-wood and therefore is more durable.

Excluding Moisture

Bacteria, insects, or fungi, get into the organic cells and by feeding on the cellulose, destroy them. By excluding heat, air, or moisture, decay can be prevented or retarded, but this method is usually impracticable, so that the cell-walls or fibres are impregnated with such a material as will prevent the destructive agents from getting in. In some cases the preservative is merely a mechanical hindrance to insects and worms, but in the case of heavy treatment it excludes air and moisture, preventing vegetable or fungi growth from developing.

Moder timber preserving is accomplished largely by the use of materials such as are found in coal tar and some metallic salts. The creosoting process is very common, but in many buildings the use of creosoted timber is not permissible, owing to the odor which is emitted and to the effect of creosote on the appearance of the wood. Some salts, such as mercuric chloride, copper sulphate, and certain arsenic salts, are fairly good preservatives, but owing to their poisonous nature are objectionable, especially in dwellings. Sulphuric and hydro-chloric acids, while destroying the fungi, are liable to injure the wood. Coal oil has been tried and is quite effective, but it increases the inflammability of the wood and causes it to emit a disagreeable odor for a considerable time. A sulphate of salicylic acid is probably as effective as creosote and leaves the timber odorless, but its expense is its objectionable feature.

The first stage in any timber preservation process consists of seasoning the wood, either by piling in the open air or by steaming in closed retorts to expel the moisture and sap. Care should be taken in piling the timber for seasoning, that a free circulation of air is allowed around the timbers. In some cases the lack of this has caused deterioration through decay before treatment took place. The bark should be removed, for often it prevents the evaporation of sap and moisture. The steaming process facilitates the removal of the contents of the wood cells, and in addition, by raising the temperature, sterilizes the wood and prevents absolute deterioration by rot as long as the outside cells are filled with the preservative. Great care is required in steaming the timber so as not to injure the wood. The cells may be damaged by the expansion of steam formed from the sap and water in the cell or they may be charred by too much heat.

Proper Seasoning

The time of year when timber is cut determines to a large extent the method of treatment. The time of cutting bears an important relation to the life of the timber and with some railroads the months are specified in which cutting is to take place. If cut in winter months when the sap is out of the tree, and placed where it can get the spring rains, the pores of the wood, being open, get water-soaked and rot quickly. On the other hand, if cut when the sap is up and placed where the hot sun will shine upon it, it will also rot very quickly—more quickly than the winter-cut, water-soaked timber. If it is piled in open cribs, however, and seasoned, it will last very much longer. Winter cuts will take some water even after six months' seasoning. The timber cut in the spring and properly stacked will, after the same seasoning, shrink considerably in cross section. The pores of the wood close up and will not absorb water even under unfavorable circumstances. The sap, particularly in oak, is a tannic acid, and when drying up closes the pores and acts as a preservative, thus rendering the wood much more durable than if it were winter cut. Also, if southern or Norway pine is cut when full of sap, the sap will commence to crystallize and turn to resin in about a month, increasing the life of the timber three or four times that of winter-cut wood.

Preservatives

The methods of treating timber with preservatives are: (1) the pressure process; (2) the non-pressure process. Each of these groups may be subdivided into two divisions, (a) the full cell process in which the cells are left filled with the preservative, (b) the empty cell process in which the preservative, after being absorbed by the timber, is withdrawn by means of a vacuum created in the retort, leaving only the cell walls coated with the preservative.

The pressure process gives a heavier and more uniform penetration and impregnation than the non-pressure process and is on this account more desirable for large structural timbers. The non pressure process is much cheaper and so is largely used for treatment of cross-ties and other timbers where a heavy treatment is not necessary and where the mechanical life of the timber is the determining factor after treatment. The full cell process leaves the timber more water-proof and air proof than the empty cell process, but the latter is largely used on account of the saving of preservative, if there is little danger of water soaking in.

Probably no branch of construction work has benefited more by the study and practice of timber treating than has the building of under-water structures. Deterioration of submarine structures may be divided into two classes, deterioration at the surface and deterioration beneath the surface. Timbers of this nature are attacked not only by rot but also by ship worms which bore into the wood and destroy the cell walls.

It is essential for the successful treatment of piling that a preservative which is insoluble in water be used and where the piles are to be placed in salt water the preservative must possess strong antiseptic qualities and resist the action of ship worms. Since a deep and thorough penetration is essential the woods of relatively high absorbing qualities should be chosen.

Some piles forming part of a dyke in Connecticut were treated by the full cell process of creosoting. They were driven about 1886 and since then have been subjected to very severe conditions. They were driven in salt water and are alternately covered at high tide and exposed at low tide. After 20 years' use many of the piles were in as good condition as when put in, and in the few cases where deterioration had set in, it was due to rot which apparently began in the top and worked down through the middle, leaving a shell. The ship worms, it seemed, had done no damage except where the timber had first begun to rot. If the top had been thoroughly protected, it is likely that no appreciable decay would have taken place.

Poles Used by Public Service Corporations

Telephone, telepraph and electric power companies consume millions of poles annually and the number is rapidly increasing. The greater number of them are cedar, with some chestnut. Since the region of supply is limited and transportation is expensive, however, cheaper woods are now being treated. According to bulletin issued by the Forestry branch of the Department of the Interior at Ottawa, an annual saving of $6.40 per mile of line may be realized by the proper creosoting treatment of cedar poles.

The preservative treatment of poles has many features to recommend it in Canada. The supply of cedar is comparatively small, and since its growth is very slow, requiring from 175 to 200 years to produce a 30-ft. pole, it is not equal to the demand. Cheaper woods, such as spruce and pine, when properly treated by preservative, are as satisfactory as cedar and they are more plentiful. This will save money and lessen the drain on the forest.

Fire-killed timbers, which occur in quite large quantities on the eastern slope of the Rockies, in a sound, strong and well-seasoned condition, should make even better poles than cedar when properly treated. They have been treated in the United States with very satisfactory results. They stand in good pole sizes and are more convenient for the extensive prairie market than poles now brought from the east.

A few years ago a power company in California set a 30 mile line with poles of western yellow pine. The poles were cut at an elevation of about 4,000 ft., and were thoroughly seasoned before treatment. About 50 per cent. of the poles were given an open tank, creosote treatment, some of the others were given a similar treatment with zinc chloride and some with crude oil. A few were given a brush treatment with carbolineum and crude oil. In order to get the comparative life of the wood, treated and untreated, stubs of untreated timber were set along the line about one mile apart.

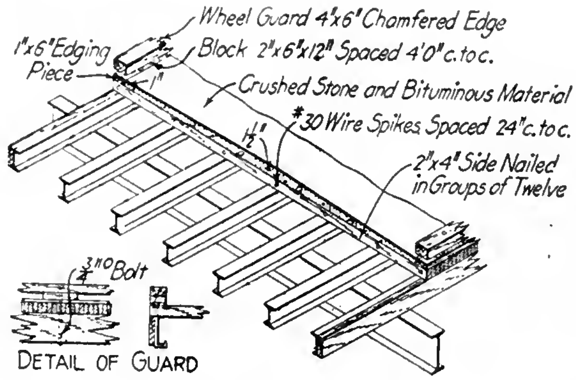
After 27 months the untreated stubs were completely rotted, nearly one-third of the brush treated poles showed decay, those treated with zinc chloride were in nearly the same state, and 45 per cent. of the poles treated with crude oil showed signs of decay, while all those treated with creosote were perfectly sound.

The question of cost governs the application of the process to a large extent. Assuming that timbers put to a certain use will last ten years without treatment, and 20 years with treatment, then, disregarding interest charges, it is evident that in order to effect a saving, the cost of treatment must at least be less than the additional cost of new timbers ten years hence. In treating on a large scale, the additional cost in most cases will not exceed the present purchase price of timbers, and so the saving secured will be at least the cost of resetting the timbers plus the advance in the price of the timber. The replacement of timber often causes loss by entailing the shutting down of the plant, as in replacing a mine shaft.

Each process of treatment has certain defined applications and the particular method to be used depends on such considerations as the cost, degree of impregnation desired, the nature of the wood to be treated and the use to which it is to be put. To secure the best results, the mechanical treatment of the wood, that is, its subjection to stress must be so arranged as not to be out of place with its chemical life. The strain should be distributed throughout the whole timber as far as possible, so that there will be no premature failure in small portions due to their bearing too great a share of the work.

A New Idea in Bridge Floor Construction

Plank flooring for bridge construction where heavy traffic is encountered is expensive and difficult of maintenance. It is necessary in some cases to re-plank floors every few months, or at least once a year. In the towns in the State of New York there are many light truss bridges which were originally designed for plank floors. The cost of upkeep on these floors is very great and the danger caused by broken planks



Placing Solid Flooring and Surface Finish.

must always be considered. The live load which they are called upon to withstand at the present time is larger than ever before, due to the great number of motor trucks and road rollers now so common. The metal of the bridge has not always had proper attention, and the result is that in the majority of cases there is not sufficient metal to carry the present live loads and at the same time permit of the use of a concrete floor. An improved method of construction adopted by the commission of highways of the State, is described in the Engineering Record as follows:—

As a money saver, and also as a means of causing less inconvenience to the travelling public, the Bureau of Town Highways of the State Commission of Highways is recommending the use of 2 x 4 inch joists in place of ordinary plank. The drawing herewith shows the method of placing this solid flooring, and the surface finish. Creosoted joists, of course, furnish the most ideal floors, and these are used in some cases, a treatment similar to that given wood blocks being applied.

Timber Treated While Laying

In order to lower the cost and at the same time keep the money for labor and supplies at home, many of the towns are providing their own treatment while actually laying the floor. Ordinary 2 x 4 inch stock is used, and is dipped in hot tar or asphalt and then allowed to drain before placing. If the wood contains much moisture or sap no treatment is given the bottom, this surface being left free for the escape of moisture or sap, which is believed to prevent rot. The joists are spiked together in blocks of ten or twelve and those blocks are toe-nailed at their ends. This is to facilitate the removal of any joint when necessary, as only a small number of the adjoining joists have to be disturbed.

Over the top surface is placed a heavy coat of hot tar or asphalt, and on this as a blotter is spread some crusher screenings or sand and gravel; some provide a thicker coat, using crushed stone, but this adds largely to the dead load. This makes a wearing surface and at the same time waterproofs the floor. This surface should be carefully preserved, but its cost of upkeep is very small.

Some of these floors have been in use for five seasons. One in particular, which is on the state highway leading down the Mohawk River just outside of the city of Utica, is heavily travelled, and yet to-day, after five seasons, is in first-class condition. On this same bridge, before providing this type of floor, the oak plank had to be entirely renewed every year, in addition to some extra attention from time to time. All of the results obtained to date favor this type of floor for light truss designs.

Satisfactory Progress on Aqueduct for Water Supply of Greater Winnipeg Water District

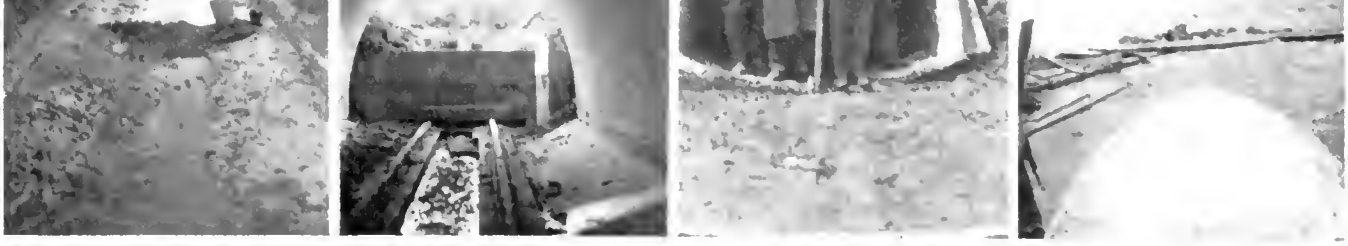
A NUMBER of illustrations reproduced herewith show various phases of the construction work in connection with the Greater Winnipeg Water District supply. It will be recalled that the city of Winnipeg voted $13,500,000 dollars to bring a supply of pure drinking water from Indian Bay in Shoal Lake, approximately 100 miles distant from the city. A concrete viaduct, of the shape shown in one of the illustrations and approximately 8 feet in diameter, is being constructed through the entire length. One of the photographs shows the method adopted at river crossings. At eight such points tunnels have been excavated under the river and the viaduct, of inverted syphon shape and standard dimensions, installed.

The undertaking included the construction of a railway paralleling the line of the aqueduct, which, with equipment, has cost the city of Winnipeg about $1,500,000. The railway construction and the rolling stock is standard and will be a valuable asset to the city after this work is completed.

An interesting feature of the work has been the discovery of a red granite quarry 71 miles out from the city, which is claimed to contain almost unlimited quantities of the finest texture granite. It has been said that this is the finest granite on the continent. A company has already been formed to work the quarry.

Another beneficial result of the work, which was probably not foreseen at the time, is that the drainage facilities provided by this construction have greatly increased the value of the land in the immediate vicinity of the aqueduct. It is said that some of the most productive land in the province lies along this line and settlers are already taking advantage of the improved conditions.

Some idea of the scope of the work may be gathered from the last monthly progress report of Chief Engineer Chace to Chairman Reynolds, of the Greater Winnipeg Water District Commission. It indicates that at five points construction is being carried forward. Three contracts are held by the Winnipeg Aqueduct Construction Co., one by the Tremblay-



Various construction views of aqueduct—Greater Winnipeg water supply.

Inside forms and carrier for outside forms.

Dyke which diverts Falcon River.

McDiarmid Co., and one by Thomas Kelly & Sons. The report, which is reproduced below, compares the activities of the early summer of the present year with that of the year 1915.

Progress for the month of May, 1916, was as follows:—

Contract 30 Aqueduct Construction	Date of Beginning Concrete, 1915
Camp 1—Commenced to pour concrete May 27th.	
Camp 2—Commenced to pour concrete May 17th.	June 14th
Camp 3—Commenced to pour concrete May 20th.	June 12th
Contract 31 Aqueduct Construction	
Camp 1—Has not yet commenced to pour concrete	June 2nd
Camp 2—Commenced to pour concrete May 31st.	June 21st
Camp 3—Commenced to pour concrete May 19th.	June 28th
Contract 32 Aqueduct Contsruction	
Camp 1—Commenced to pour concrete May 15th.	July 7th
Camp 2—Commenced to pour concrete May 16th.	June 7th
Camp 3—Commenced to pour concrete May 17th.	June 7th
Contract 33 Aqueduct Construction	
Camp 4—Commenced to pour concrete May 19th.	July 12th
Camp 5—Commenced to pour concrete May 25th.	July 7th
Contract 34 Aqueduct Construction	
Camp 6—Commenced to pour concrete May 20th.	July 6th
Camp 7—Has not yet commenced to pour concrete.	
Camp 8—Commenced to pour concrete May 17th.	
Contract 54 Cement	
6,580 barrels of cement were supplied during the month, making a total of 8,460 barrels for 1916.	
Head Office Staff	
Was engaged in preparation of detail plans and in general routine work.	

The work is in charge of the Greater Winnipeg Water District Commission. When completed, pure water will be supplied to Winnipeg, St. Boniface, Fort Garry, East Kildonan, West Kildonan, St. Vital, and Assiniboia. The general manager and engineer in charge is Mr. W. G. Chace. The consulting engineer is Mr. Fuertes, of New York.

Fine New School for Sarnia

CONTRACTS have just been closed by the Sarnia School Board for a modern eleven roomed Public School, to be erected in that city, plans of which were prepared by S. B. Coon & Son, School Architects, Toronto.

The various floors of the building will be utilized as follows:—Ground floor—industrial training and domestic science departments, playrooms, lavatories finished in marble and equipped with sanitary fixtures, heating and ventilating chambers and storerooms. First floor—4 standard class rooms, kindergarten, 34 ft. x 42 ft., with solarium bay, teachers' and principal's rooms. Second floor—six standard class rooms and library.

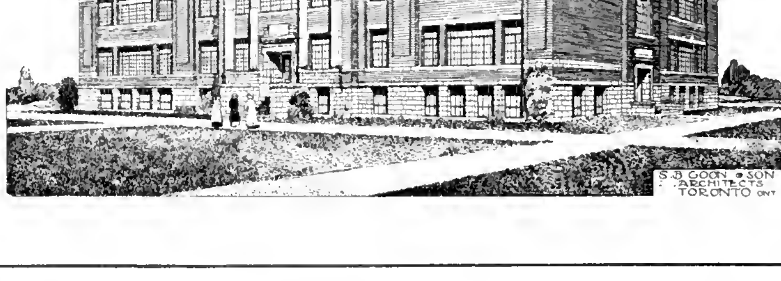
The class rooms will be finished with hard wood floors, slate blackboards, modern seating, and will have spacious cloak rooms in connection with each. An assembly is arranged for by means of sliding partitions between the kindergarten and rotunda.

The exterior will be of red brick, with cut stone foundation and trimmings. The general construction will be semi-fireproof, with steel stairs, terrazzo floors on ground, first, and second floors. Steel casement sash will be used throughout.

Low pressure, automatically-controlled steam heating and electric fan ventilation will be installed. The school is planned for future extension when desired. Schultz Bros., Brantford, are the general contractors.

A test of the flat slab construction of the new Simpson Building, Mutual Street, Toronto, will be conducted by Professor Gillespie, of the University of Toronto, and Mr. W. W. Pearse, city architect, with the object of determining accurately the stresses in the concrete and the reinforcing. A similar test is also planned for the new T. Eaton Company warehouse. The Simpson building was designed by Chicago engineers, while the Eaton one was planned by Philadelphia engineers, and the designs are carried out according to the by-laws of the respective cities. The tests will, therefore, provide interesting comparative results.

Owing to the rapid increase in their business, the John V. Gray Construction Co., Ltd., have removed from No. 348 to No. 625 Confederation Life Building, Toronto, where they will have larger quarters.



Brick Pavements—The Material and Methods Used in Their Construction

By H. E. Breed*

SO much has been written about brick pavements, the building, the selection of material, and the methods used in their construction, that most of you are doubtless thoroughly familiar with the subject from a theoretical as well as practical standpoint. I feel safe in saying that, with the exception of a few minor refinements, very few changes have been contemplated during the past two years. Appreciating your familiarity with these conditions, I thought it might be most profitable to tell of the work that I know best along that line; that is, the practices and methods of constructing brick pavements in the State of New York; such methods as need extra precaution and care; some of the difficulties encountered in sampling and testing; new departures in the form of construction; the number of miles constructed; the average cost per mile; and, in so far as can be given, some data concerning the relative maintenance cost, not exactly of the pavement proper, but of the highway as a whole.

Practices and Methods

It is not my intention to cover all the features of construction. Instead, I should like to emphasize a few of the features often overlooked or only perfunctorily considered, which the work of our department has proven to be of fundamental significance in the success of brick pavements. Other features of equal importance I omit because they have received so much general attention.

In the finished pavement the greatest objection seems to be the longitudinal cracks which appear after the pavement has been down some time. These appear more often on the highways in the country districts than they do in the city streets where there are curbs, sidewalks, and cut-off drains on both sides of the road. This would indicate that on the country highways the cracking comes mostly from a wet subgrade in which there is a certain amount of seepage from the ditches and is due in the main to subsequent frost action; while in the cities where the whole roadway has a protective covering there cannot be quite so large an amount of seepage and therefore we find fewer cracks.

To this end, I should like to emphasize the necessity of adequately draining the subgrade. If we are to build a type of pavement as expensive as brick, the small additional expense needed for drainage is amply justified in comparison with the large initial cost.

It is the opinion of the writer that a sand cushion should not be greater in depth than one inch. This means that the foundation must be uniformly smooth, with the sand cushion acting merely as an evener of the surface. It has been claimed that the sand cushion prevents the crushing of the brick and gives an amount of resiliency that is necessary to a pavement of this type. This statement, however, is not borne out in practice, for I have observed a five-year-old pavement in which a mortar cushion was used that has been bettered by the lack of so-called resiliency.

Another point to which it has been necessary to give very careful attention is the washing of the brick. Many times brick are stored in piles along the road so long in advance of the construction work that they are so spattered with mud from passing traffic and so covered with dust that it is doubtful whether the grout will properly adhere to them. In all cases of this kind I strongly urge that the brick be thoroughly washed so that the grout will have an opportunity to perform its full function in cementing them together. It is well known that if the grout does not perform this function the individual bricks become loose and the sand cushion shifts on the absorption of moisture so that in a short time it is badly in need of repairs. A large percentage of the bad results which we discover in our maintenance work is due to the fact that the grouting did not perform its full function and cement the brick firmly together.

The smoothness of the finished pavement depends largely on the smoothness of the foundation. A little extra care in this respect will amply repay any contractor. Longitudinal expansion joints should be in place before the brick are laid. Good transverse alignment is essential. It is pleasing to the aesthetic sense; it gives workmanlike look to the job, and the curves are more easily worked out if the courses are straight. Every few courses should be straightened by lightly driving the rows to place with a sledge on a 3 by 4-in. timber, 3 ft. long, laid in front of the brick.

Bats less than 3 inches should not be used. If necessary, trim the second brick to accomplish this. The bats should be obtained from bricks culled from the pavement, and as every brick is worth from 3 to 4 cents, in the pavement, the selection of bats should be made from culls so that the good half can be saved. This is an element of fairness to the manufacturers which all engineers will appreciate.

Never roll a brick pavement on a wet cushion.

In order to properly grout a brick pavement, the bricks should be thoroughly sprinkled first. Great care should be given to the thorough mixing of the grout (sand, cement and water) first dry, then to a plastic consistency, and gradually thin out until the mixture just reaches the consistency which will flow. In this manner we are assured of getting the best results. Grout should be applied as soon as mixed, and from mixing to application should be constantly agitated to avoid segregation. Two applications of grout are necessary. The first should merely fill the joints, and the surplus should be swept in with rattan brooms. Just as soon as the first grout has settled and before the initial set can take place, a second application, of slightly thicker grout, should be spread, which should be squeegeed as soon as it is slightly settled, working the squeegee over the bricks at an angle with the joints and leaving them filled flush. In our work we are allowing the contractor to use one part of cement to two parts of sand where they use some form of grout machine. Where they mix by hand in boxes we require them to furnish grout with one part of cement to one part of sand.

Sand

Many bad results in brick pavements can be directly attributed to the use of poor sands. The inconsistency of present day practice is shown by testing the cement and brick both with a fine degree of engineering precision, and trusting the other material, sand, to visual guesswork.

Three different and distinct kinds of sand are used in brick pavements; concrete sand, cushion sand, and

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grout sand. Concrete sand should be clean and have at least 80 per cent. of the strength of Ottawa sand in compression. Its gradation should be as follows:—

Passing the ¼-in.	100 per cent.
Passing the No. 6	85 per cent.
Passing the No. 20	60 per cent.
Passing the No. 50	25 per cent.

and a variation of not over 5 per cent. from these figures should be allowed. Sand with over 8 per cent. of loam should be rejected. This may seem to be rigid specifications, but if a foundation is to serve its purpose it should be strong enough to sustain the pavement with the minimum amount of cracking.

Cushion sand should be of such a nature that 100 per cent. will pass a No. 6 screen and it should not contain more than 20 per cent. of loam.

Grout sand should be clean and of such a nature that it shall have not more than

100 per cent. passing a No. 6
85 per cent. passing a No. 20
30 per cent. passing a No. 50
5 per cent. passing a No. 100

and it shall be rejected if it contains more than 5 per cent. of loam.

Difficulties Encountered in Sampling and Testing

Many of the shale blocks being used to-day show great differences in color produced by different grades of burning. Sometimes there are as many as four or five different shades. In sampling, the department has found that this fact, properly considered, is a valuable aid for the determination in the laboratory of what block may be rejected, and for the information of the inspector in the field when the final culling in the pavement takes place; especially so because there is an observable relation between the shades of color produced by burning and the results of the rattler test. We have, therefore, instructed our men to choose samples according to the different colors and textures and to keep duplicate samples of the same shade and texture to be a good guide to the selection and rejection of the poor brick when the results are determined from the laboratory tests, for any person thoroughly familiar with a given brand of brick and the results of the rattler test on the different shades will be able to cull accurately by visual inspection. This does not apply to all classes of block, for many of them are practically of a uniform range of color. But I know of a number of cases in which it has been of very valuable aid in enabling us to get results procurable in no other way.

It has been suggested at various times, both by manufacturers and by some engineers, that it might be advisable to test brick at the plant. The writer has given this subject careful consideration, and it seems to him that the present practice of sampling and testing brick in the field insures better results than testing at the plant, for the following reasons:—

Brick are not manufactured uniformly in the same sense that cement or asphalts are manufactured as uniform products.

Long experience with a given brand of brick is necessary before they can be accurately culled by visual inspection.

The men best fitted to cull brick by visual inspection are the employees of the brick company.

The sampling from the different benches of the kiln to show the variations in burning can be done more accurately by the burner than by an inspector.

Variations in temperature in different parts of the kiln give different qualities of brick. These can be assorted and selected best by the men who burn them.

Factory inspection of brick places the responsibility of uniform shipments of acceptable brick on the inspector, and offers an opportunity to the brick company to dispose of cull brick because of their lack of responsibility in the selection.

During the last year this department tested 269 lots of brick, comprising 22 different brands and representing a total of 27,000,000 brick. Of these 13.6 per cent. failed to meet the specifications and were rejected. This does no include the amount culled by the inspectors and rejected on the work; which, in some cases, is rather large. With brick tested at the plant, it seems to the writer, that our chances for getting good material would decrease, for if the manufacturers were willing to take such a long chance with a large outlay of freight and handling involved, they would certainly be willing to give inferior material at the plant and would load some brick from the kiln which would not be good enough to go into the work.

New Departure in the Form of Construction

During the past few years two types of new construction have been advocated; one known as the monolithic form, in which the brick are made an integral part of the foundation, and the other the mortar cushion type. Both these have many advantages according to the claims of their advocates. It is the intention of our department this year to try some brick laid with the mortar cushion, and it is our intention in building this type to use some 3-in. and some 3½-in. brick in order to gain economy in the saving of freight charges and handling. It has the advantage of closely approaching the monolithic form of construction, and in that way gives added strength to the pavement. Another advantage is that there can be no failures from swelling or shrinking of cushion sand, and should the pavement crack, only the crack will be affected, and not the whole structure, as is the case when a sand cushion is used.

Number of Miles Constructed and Average Cost Per Mile

Up to January 1, 1916, New York State had completed 238 miles of brick pavements. These different pavements are of varying age and I will later tell briefly of the cost of maintaining them.

The average cost for brick pavement on 5-in. concrete foundation is per mile of 16 to 26-ft. highway, $25,750. The average cost per square yard of pavement only is $2.015. These figures were obtained from an average of 23 highways.

In order to get a comprehensive cost of other types in New York State, I will give figures on water bound macadam, bituminous maradam, and cement concrete.

Water bound macadam:—

Cost per mile of 16-26-ft. highway $10,250
Cost per sq. yd. of pavement only 0.648

The cost per square yard was obtained from 434 values and the cost per mile from 419 values.

Bituminous macadam:—

Cost per mile of 16-26-ft. highway $12,970
Cost per sq. yd. of pavement only 0.871

Both of these items were obtained from the average of 134 highways.

Cement concrete, 6 in. thick:—

Cost per mile of 16-20-ft. highway $15,320
Cost per sq. yd. of pavement only 1.121

Both of these items were obtained from an average of 20 highways.

It will be noted that the difference between the pavement cost and the total cost of the highway lies, in all cases except brick, between $4,000 and $5,000. The reason why the cost of items other than pavement is apparently high on brick roads lies in the fact that the cost of edging has been excluded from the pavement cost, and included in the total cost.

It may be interesting to note that up to January 1, 1915, there had been built in the State of New York 5,167.19 miles of all kinds of highways; during 1915 this department built 1,083.35 miles, making a total of 6,250.54 miles of road. At the present time there are 783.05 miles under contract, which are not completed.

Relative Maintenance Cost of the Whole Roadway

The maintenance charge for 238 miles of brick for the year 1915 was $41,840, or approximately $176 per mile per year. This amount was increased to a large extent by a number of our older pavements which had many replacements. If we eliminate those we find that we would have 107.91 miles of brick pavement which cost $14,185 to maintain and repair. This is at a cost of approximately $131 per mile. These figures, as we mentioned at first, are not the figures from the pavement alone and they include such treatment as cleaning ditches, cost of patrol where patrol was needed, fixing the shoulders which are cut up by the turning out of traffic, the cleaning of slides and maintaining of guard rail. From observation I think it would be safe to say that about 30 per cent. to 40 per cent. of this cost is the average cost that would cover the maintenance of the pavement alone, although in some cases for a series of years, there is practically no cost to the pavement proper.

With these figures it may be interesting to note the cost of maintenance of other types of pavement during the same year computed on the same basis as that for the brick roads, i.e., including the maintenance of guard rail, shoulders, ditches, patrol, etc., as well as the surfacing.

For gravel we find that is cost $577 per mile for 192 miles of road; for water bound macadam we find that it cost $564 per mile for 2,298 miles of road; for penetration method bituminous macadam we find that it cost $448 per mile for 2,387 miles of road; for bitmuinous macadam, mixed method, it cost $181 per mile for 63 miles of road. For second class concrete roads requiring surface treatment it cost $532 per mile for 295 miles of road; for cement concrete pavement, 1:1½:3 mix, it cost $129 per mile for 84 miles of road.

The best results are obtained in brick pavements as in all other engineering works, by strict adherence to details of workmanship and rigid inspection, for in any engineering work or any work of importance and of a contractural nature, inspection is necessary, for it is human nature to get as much out of any situation as is possible. Where contractors are perfectly honest and put all the materials called for in the work, doing it to the best of their ability, it often fails or gives results not commensurate with its cost. This is probably shown to greater extent in highway construction on account of the many new and different types of construction of which often none of the men on the ground have much knowledge. Rigid inspection should be given all construction work and one man at least on every piece of work should have adequate knowledge of the type of pavement to be constructed. He should be selected by virtue of his knowledge of this type and general constructural work, always keeping in mind the personal equation of the man under consideration, his ability to carry out and complete the work in hand. Where inspectors of this kind are not to be had, they should be trained and only those who are proficient and do good work should be kept in this capacity, for the ultimate result is mainly dependent on them.

In conclusion, it is the opinion of the writer that while many good brick pavements have been built, there is still room for improvement in this branch of engineering work and in reaching out for any betterments that are possible, it is hoped that some of the suggestions in this paper will be of help in future work.

Canadian Manufacturers' New President

Thomas Cantley (Hon.-Col.), the president for the coming year of the Canadian Manufacturers' Association, is the president and general manager of the Nova Scotia Steel and Coal Company, and well known the world over for his activities in connection with the iron and steel industries. Like many another prominent figure of modern times, he started business life as a telegraph operator, with the Intercolonial Coal Company. In 1885 he was appointed general sales

Hon.-Col. Thomas Cantley.

agent of the Nova Scotia Steel Company, and has risen rapidly through the various offices of secretary, assistant manager, joint manager, member of board of directors, and general manager (1901), second vice-president (1909), president and general manager (1915). He has travelled widely on this and the European continent, making a close study of the steel industry, which has resulted in the works at Sydney and New Glasgow being among the most efficient and modern in the world. Col. Cantley was born in New Glasgow in 1857.

The summaries of trade imports and exports for the twelve months ending March 31, 1916, just issued by the Dominion Government, are extremely gratifying compared with those of 1915. Imports for that year were $587,304,363, and in 1916, $542,043,563. Exports for 1915 totalled $490,808,877, while in 1916 they increased to $882,872,502.

In the Public Eye

A budget of comment presented in the interest of public welfare, independent of party politics and with malice toward no one.

ROSS RIFLE AGAIN

Startling indeed in view of the attitude adopted by the official and unofficial apologists of the Ross rifle is the news contained in the London letter to the Toronto Telegram. Briefly, the correspondence is to the effect that following complaints from all branches of the service, Gen. Alderson, in command of the Canadians, formally protested to the Canadian Government against arming the men with the Ross rifle, which has proved, according to the soldiers, a failure and a pathetic failure at Ypres and was later to be followed by a similar failure at St. Eloi.

General Alderson's protest was received and answered in a style that unfortunately for the good name of the Dominion is becoming to be regarded as characteristic of the administration of the militia department. He was told to mind his own business and the Canadian soldiers were told to take what the militia department considered good for them and were warned that any further objections to the use of the Ross rifle would not be tolerated. The printed circular containing this warning was apparently an artfully contrived defence of the rifle and an obvious attempt was made therein to blame the faults of the arm on the quality of the ammunition used by the troops.

The main point and the point that will appeal to most people who have little or no knowledge of what constitutes a good military rifle or makes a bad one, is that the men who are using the weapon should be the best judges of its fitness for the work they have to do. When a man's life depends upon the quality of the weapon which is his sole individual defence, he is apt to be curious about it, he is likely to watch its effect and eager to learn all about its dependability, or otherwise, in a crisis. In the case of the Ross rifle there seems to be little doubt that it was unsuitable in the opinion of the vast majority of the men armed with it. That in itself should have been sufficient to cause an investigation of the most careful and painstaking kind. Instead, we are compelled to hear that the protests of the men expressed through their officers and divisional commanders, were received with disdain, and that eventually the Canadians were collectively reprimanded for their attitude and warned that no further nonsense would be tolerated. This to men who were willing and ready to face death for the Empire, and who, it seems to us, should have been given every consideration and whose opinions should have been respectfully listened to and met, if possible. Putting aside all consideration of the technical faults or merits of the rifle, it would seem that it would have been a wise policy to have made a more tactful reply and to have demonstrated to the troops that they were not being sacrificed for political reasons or for any other reason. If the morale of the troops depended on a change f rifle, it should certainly have been effected, and at once. This aspect of the matter would seem to be the common sense view of the dispute.—Ottawa Citizen (Independent Conservative.)

The Toronto Harbor Commissioners have deposited with the Minister of Public Works a description of the site and plans of the bascule bridge proposed to be built across the Don division channel at the foot of Cherry Street.

Personal

Messrs. Smith & Smith have been appointed engineers for Victoria County, Ont.

Mr. A. F. Macallum, former city engineer of Hamilton, Ont., who takes up his duties as commissioner of works in Ottawa, on July 1, was recently presented with a handsome case of pipes and two humidors of tobacco by James Weedon, on behalf of the district and outside foremen, who, at the same time, expressed their disappointment because of his departure.

Mr. J. W. B. Blackman, city engineer of New Westminster, B.C., has been awarded first prize by the Institute of Municipal and County Engineers for an article on the construction of the 25-inch water main and the 13-inch submerged main to Richmond. The Institute has a membership of about 4,000, including practically every city and municipal engineer in Britain and many in the Overseas Dominions. Every year a publication is issued, in which is printed articles from members on matters of professional interest, and the council of the Institute awards three prizes for the three best articles for the year.

Obituary

Lieut.-Col. F. A. Creighton's name appears among the list of those recently fallen in France. Col. Creighton was formerly city engineer of Prince Rupert, Sask., but later has had his head office in Winnipeg, where he carried on a consulting engineering business. Some little time ago he was awarded the Legion of Honor for conspicuous work at the front.

S. H. Reynolds, chairman of the Greater Winnipeg Water Commission, died at the home of his cousin in Chicago on June 16. Mr. Reynolds' early home was in St. Catharines, Ont., of which city he was at one time city engineer. Later, for a number of years, he was assistant to City Engineer, Col. Ruttan, of the city of Winnipeg, but resigned in 1907 to follow the practice of consulting mining engineering in Vancouver, B.C. In 1913 he was appointed chairman of the Greater Winnipeg Water Commission, since which time he has devoted himself entirely to this work.

Col. H. J. Bowman, county clerk of Waterloo, Ont., and senior member of the well known consulting firm of Bowman & Connor, died recently in the hospital in Berlin. Col. Bowman took a very active interest in engineering and military affairs. He was a graduate in 1885, of the Toronto S. P. S., at which time there were only five members in the graduating class. He was formerly town engineer of Berlin, and since 1898 has been a member of the local Water Commission, in addition to vigorously following his profession in the construction of roads, bridges, waterworks plants, etc.

Lieut. H. J. Haffner, formerly the senior member of the firm of Messrs. Haffner & Wartell, civil engineers, Victoria, has been killed in action. Lieut. Haffner was in charge of the machine gun section of the 48th Battalion, which left Victoria last June, but on account of his expert engineering knowledge, he was transferred to the corps of engineers on reaching England. He was a native of Elora, Ont., but had lived in British Columbia for several years prior to the outbreak of the war, having followed the profession of civil engineer during most of that time, and in that capacity he was engaged in the construction of the famous Windermere Road. He was 35 years of age.

Building operations in Quebec, P.Q., continue quite brisk. Building permits to the amount of $144,410 were issued one week recently, one of them, for $55,000, covering an additional storey and repairs to the Commercial Academy on Cook Street.

Mainly Constructional

East and West—From Coast to Coast

The aldermen of the city of Hamilton, Ont., favor the insertion of fair wage clauses in all city contracts.

The Toronto Painters' & Decorators' Association has been incorporated, with head office at Toronto, the provisional directors being Charles Caplan, Louis Bloom, Abraham Price, David Langer, and Mendel Pullen.

The Packard Electric Company, St. Catharines, Ont., are erecting a factory addition, 50 ft. by 145 ft., two storeys high, steel or reinforced concrete construction, brick curtain walls, plank floors, felt and gravel roof. A. E. Nicholson, St. Catharines, is the architect.

The Standard Steel Construction Co., of Port Robinson, Ont., has leased the factory occupied by Dominion Canners and will use this building as an addition to its plant. The new building will be re-equipped and in operation by September, when 200 additional hands will be employed.

Representatives of several municipalities in the Ottawa Valley, in that section between Ottawa and Petawawa, are urging the construction of a trunk road between these two points, and a committee has been appointed to take up the matter of an Ottawa Valley organization for the promotion of the scheme.

The Foundation Co., Ltd., Montreal, have been awarded two contracts by the Algoma Steel Corporation, Soult Ste. Marie, Ont. One is for the revision of the Corporation's yard, the work including the engineering and construction of three through plate girder bridges. The other contract is for the construction of the foundations of two open hearth furnaces, and gas producer plant.

The Electric Reduction Company, Buckingham, P.Q., have let a contract to the Foundation Co., Ltd., Montreal, for a large phosphate plant, on a site 120 x 90. The foundations and floors will be of reinforced concrete, and the superstructure of steel and brick, with asbestos protected metal siding and roof, the latter supplied by the Canadian Asbestos Co., of Montreal. The Dominion Bridge Co. will supply the steel. The engineer is Mr. J. B. McRae, of Ottawa.

At a conference recently with the York County Council, Mr. Geo. H. Gooderham, M.P.P., chairman of the Toronto-Hamilton Highway Commission, asked that a sub-committee of the council be appointed to confer with a committee of the Peel County Council and the Highways Commission, in regard to the reconstruction of the bridge over Etobicoke River. Mr. Gooderham stated that the bridge was too light for the traffic and should be replaced with a stronger structure.

A large caisson, built in connection with the bridge at Moncton, N.B., was recently floated out into the river and moored at the desired point, but the following day it was carried adrift down stream to a point about 400 or 500 feet below the bridge. The contractors hope to save the caisson and will endeavor to raise it when the present high tides fall off. Its cost was about $12,000 or $15,000, and it weighed about 400 tons, having a base of 18 inches of concrete.

September 26th is the date set for the linking of the two arms of the Quebec Bridge, connecting the north and south shores of the St. Lawrence. The huge centre span, weighing 7,000 tons, and measuring 640 feet, will be towed to its position under the bridge, hoisted 110 feet and riveted into position. Captain Haakon Kjerland, Superintendent of the Quebec Salvage and Wrecking Co., will be in charge of this important work, for which the time allowed will only be one hour on account of the heavy tide current.

According to a statement made by Mr. Workman, the president of the Dominion Steel Corporation, at the annual meeting of the shareholders, held recently, it is the intention of the firm to make a number of improvements to their steel plant, the policy being to secure the utmost efficiency and thus reduce costs. The first steps along these lines have already been made in the remodelling of two of the older blast furnaces on the most approved modern lines.

The County Commissioners have asked permission to build a new bridge over the Humber River at Bloor Street, Toronto, at an estimated cost of $25,000, to replace the bridge which was carried away by the spring freshet. The bridge needed will have to span 210 feet and stand up against a very strong current, as well as ice. The county council have decided to inspect the site and get an idea of the form of construction best suited. A temporary bridge, which was erected at a cost of $700, is at present in use.

At a recent meeting of the Ontario Society of Domestic, Sanitary, and Heating Engineers, held in London, Ont., Frank R. Maxwell, of Toronto, was elected president; Fred H. Gentle, of Toronto, was chosen vice-president, and Thomas H. Maxwell, also of Toronto, treasurer. The secretary, G. F. Frankland, of Toronto, was re-elected to that office. The engineers decided that a standardization of plumbing was required, and passed a resolution that the matter be pressed further and that the Provincial Health Board be asked to deal with it at an early date.

Plans for the new Customs House and examining warehouse, to be erected in Toronto, have been recently received in the city. The new building, which will be erected on the site of the present Customs House, and which will be of fireproof construction, will be seven storeys high and will face on Front Street, covering an acre of ground. It will be of grey granite, finished with grey sandstone or Tyndall limestone. Seventeen three-quarter Doric columns, seven feet in diameter and 67 feet in height from the base to the top of the cap, will adorn the front, and three more may be added if the building is extended westward later.

Building and construction work at Sarnia, Ont., now pending approval by the various municipal departments, include, the erection of a new $60,000 school on Lochiel Street, the construction of new sewers, the grading of East Street and Davis Street, the construction of a sewer outlet for six acres of land in Sarnia Township, the improvement of the Fourth Line drain by the installation of 36-inch and 4-foot tile at a cost of about $23,669. The Council granted the request of the Fire and Water Committee to have three cement wells sunk at the lake shore near the 18th and 19th infiltration basins at the new waterworks. The cost of this work is estimated at $5,000.

Trade Publication

Water screens -Folder No. 64, by the Chain Belt Co., Milwaukee, describing their travelling water screens. These are designed primarily to remove refuse and foreign material from water before it enters power plants, steel mills, or any other industrial plant requiring large quantities of clean water.

Accelerating the Hardening of Concrete

Experiments made by the United States Bureau of Standards appear to show that 4 per cent. of calcium chloride added to the mixing water increases the strength of concrete at the age of one day 100 per cent. or more. In some cases the strength of the concrete, in which calcium chloride was used, at the age of two days represented an increase of 75 per cent. or more on the strength normally attained in one month.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Hespeler, Ont.
Tenders will be received until July 6th for excavation, pipe laying and back-filling required in the construction of about 2,500 feet of watermains. Specifications with the Town Clerk, M. E. Jardine.

Kingsville, Ont.
The Town Council will submit a by-law on July 5th to authorize the expenditure of $16,000 on waterworks improvements. Clerk, George Pearse.

London, Ont.
Tenders will be called very shortly for the construction of storm and sanitary sewers, estimated to cost $5,000. Engineer, H. A. Brazier.

The City Council contemplate the construction of storm sewers at an approximate cost of $25,000, and plans will be prepared by Engineer J. A. Brazier.

Minto Township, Ont.
The Township Clerk, W. D. McLellan, Harriston, Ont., will receive tenders until July 10th for the construction of Municipal Drain No. 7. Specifications and profile at offices of C. D. Bowman, C. E., West Montrose, and of the Clerk.

Pembroke, Ont.
The Town Council are considering extensions to the sewerage system, which may necessitate the installation of a pumping plant. Engineer, J. W. Moore.

Ridgetown, Ont.
A By-law has been carried authorizing the borrowing of $10,000 for extensions to the waterworks system.

Sarnia, Ont.
Tenders will be called shortly on the construction of three concrete basins and laying a quantity of 18-inch steel pipe, estimated to cost $5,000. Engineer, John Baird, 166 Queen Street.

Saskatoon, Sask.
Commissioner Yorath will receive tenders until July 24th for the construction of a force water main, estimated to cost $20,000. Engineer, G. H. Archibald.

The Provincial Government Board of Highway Commissioners will call for tenders on the laying of asphalt pavement on a bridge, estimated to cost $26,000.

Toronto, Ont.
The Board of Control will receive tenders until July 4th for the construction of sewers on Ivy Avenue and two lanes. Specifications at office of the Works Department.

The Board of Control will receive tenders until July 4th for the supply of 4-inch stop valves for the High Level Pumping Station. Specifications at Room 12, City Hall.

CONTRACTS AWARDED

Dundas, Ont.
A contract for construction of sidewalks has been awarded by the Town Council to the Artificial Stone Paving Company, Simcoe. Approximate cost, $5,500.

Guelph, Ont.
The City Council have let a contract for construction of concrete sidewalks to Palmer & Palmer.

Harwich Township, Ont.
The Township Council have let the contract for construction of the Hartwick Drain to L. Gillier and A. E. Zimmer, Northwood, at $4,700. Engineer, G. A. McCubbin, 135 King Street, Chatham.

Ottawa, Ont.
The City Council have awarded the contract for construction of a pavement on Albert Street to the Union Construction Company, Bank Street Chambers.

Toronto, Ont.
The Board of Control have awarded the contract for supply of 5-inch vitrified paving blocks during the year to United Brick Company, at $25 a thousand.

The following contracts have een let by the Board of Control:—asphaltic concrete pavement on Isabella Street, Commissioner of Works, at $6,905; bitulithic pavement on Moore Avenue, Commissioner of Works, $19,728; brick block on one lane, Ramsay Contracting Company, 39 Indian Road Srescent, $1,737; sidewalks, E. Bushell, 31 Silverthorne St., and Godson Contracting Company, Manning Chambers.

Trenton, N.S.
A contract for construction of watermains has been let by the Town Council to Gammon & Weir, Archimedes Street, New Glasgow. Approximate cost, $8,150.

Railroads, Bridges and Wharves

Lambton County, Ont.
Tenders on the construction of a bridge over Bear Creek will be called when the specifications are ready. Estimated cost, $7,000. County Clerk, John Dalziel, Sarnia, Ont.

London, Ont.
The City Council have decided to defer the construction of the proposed breakwater extension at West London until some future date.

Wheatley Township, Ont.
A new 35-foot span is necessary for the Two Creeks Bridge and the Township Council will take up the matter with the County Council. Township Clerk, J. W. Kennedy, Wheatley.

CONTRACTS AWARDED

Dundas, Ont.
The Public Utilities Commission have let the contract for construction of a concrete dam to McAllister & Taylor, Hamilton, at $6,800. Engineer, E. H. Darling, 601 Spectator Building, Hamilton.

East Williams Township, Ont.
The Township Council have let a contract for the construction of two steel and concrete bridges to the Petrolia Bridge Company, Petrolia.

Finch Township, Ont.
The Township Council have awarded the general contract for construction of concrete bridges to McMillan & McRae, Berwick, Ont., at $3,800. Contractors will require quantities of steel and cement.

Miniota, Man.
The Municipal Council have awarded the contract for construction of two reinforced concrete culverts to W. B. Ronan, Miniota, at $2,983.

Restigouche County, N.B.
The Provincial Department of Public Works have let the contract for the substructure of a bridge in Durham Parish to A. E. Syme, Alma, Albert County, at $5,000.

Russell, Man.
The Municipal Council have let a contract for construction of reinforced concrete bridges and culverts to Alexander Scobie, 74 Isabel Street, Winnipeg, at $5,284.

Westbourne, Man.
The Municipal Council have awarded the contract for construction of two bridges to Snyder Brothers, Portage La Prairie. Approximate cost, $3,667.

Public Buildings, Churches and Schools

Brantford Township, Ont.
Tenders on all trades required in the erection of a school will be received until July 8th by the Architect, F. C. Bodley, Temple Building, Brantford. Brick and steel construction. Approximate cost, $9,000.

Galt, Ont.
Tenders are now being received for the erection of a school, estimated to cost $50,000. Architect, J. Evans, Scott & Bennett Block, Water Street North. Brick construction.

Marieville, Que.
The Architects for the proposed Parish Church of Ste. Marie de Monoir are Viau & Venne, 76 St. Gabriel Street, Montreal. Steel and stone construction. Approximate cost, $150,000.

Montreal, Que.
Work is about to start on the erection of a building on St. Lawrence Boulevard for the Deaf & Dumb Institimated cost, $280,000. Architects, Gauthier & Daoust, 180 St. James Street. Stone, brick and terra cotta construction.

Portage la Prairie, Man.
The by-law to authorize the erection of a school has been carried. Architect, Frank Evans, 901 Confederation Life Building, Winnipeg. Approximate cost, $45,000.

Quebec, Que.
Tanguay & Legon, 20 d'Aguillon St., have appointed Architects for the proposed Hospital for the Anti Tuberculosis League, and are now preparing plans. Estimated cost of building, $100,000.

Southampton, Ont.
Tenders will be received until noon, July 3rd, by the Department of Indian Affairs, Ottawa, for additions and alterations to a school on the Saugeen Reserve. Plans and specifications at office of T. A. Stout, Indian Agent, Chippewa Hill, the Post Offices at Port Elgin and Paisley, and at the Department.

Trail, B.C.
Plans of a school are being prepared by J. N. Barnet. Brick and concrete construction. Estimated cost, $15,000.

Walpole Island, Ont.
Tenders on additions and alterations to the school on the Indian Reserve will be received until noon, July 3rd, by the Deputy Superintendent General of Indian Affairs, Ottawa. Plans and specifications at offices of the Indian Agents, Walpole Island and Sarnia, at Wallaceburg Post Office and the Department.

Winnipeg, Man.
The School Board propose to build a five-roomed school on McPhillips Street, and plans will be prepared by Building Commissioner J. B. Mitchell. Approximate cost, $30,000.

CONTRACTS AWARDED

Brinsley, Ont.
Work has been started on the erection of a brick school, estimated to cost $4,000. General contractors, Elson & Son, Parkhill, Ont.

Carnduff, Sask.
The general contract for the erection of a hall for the Independent Order of Odd Fellows has been let to N. J. Ash, Carnduff. Brick veneer construction. Approximate cost, $4,500.

Coaldale, Alta.
The general contract for the erection of a school has been awarded to the Bennett & White Construction Company, 1928 17th Avenue North, Calgary. Brick and hollow tile construction. Approximate cost, $18,000. Prices are wanted on material.

Kinburn, Ont.
The contract for heating and tinsmithing required in the erection of a school for School Section No. 5, Fitzroy, has been let to James Smart Manufacturing Company, Brockville. All other work by general contractor.

Kingston, Ont.
The contract for masonry and carpentry required in the erection of an Orange Hall have been let to R. N. F. McFarlane, Johnson Street, plumbing tinsmithing to Simmons Brothers, Princess Street, and painting to T. Milo, Princess Street.

Ponteix, Sask.
In connection with the convent now being built for the Roman Catholic Congregation, the contract for heating and plumbing has been awarded to W. E. Walker, Weyburn, Sask. Remainder of work by general contractors.

Quebec, Que.
The general contract for an addition to the Jeffrey Hale Hospital, St. Cyrille Street, has been awarded to L. H. Peters, Limited, 10 St. Angele Street. Approximate cost, $50,000. Architect, T. R. Peacock, 81 St. Peter Street.

In connection with the erection of a chapel for Patronage Laval, St. Sauveur Street, the masonry contract has been let to J. Chevalier, 44 Renaud Street, carpentry to E. Morissette, 234 Latourelle Street, and roofing to A. Durand, 42 St. Agnes Street.

In connection with the erection of a College for the Commercial Academy, Cook Street, the contract for painting has been awarded to Gauthier & Brothers, 292 Joseph Street.

St. John, N.B.
The general contract for the erection of St. Vincent Girls' High School on Cliff Street has been awarded to John Flood, 123 Duke Street. Estimated cost, $150,000. Architect, C. W. West, Post Office Box 13, Hampton, Kings County.

St. Julienne, Que.
The general contract for the erection of a Presbytery has been let to P. Brouillett, 2879 Christope Colomb Street, Montreal. Architect, J. O. Turgeon, 55 St. Francois Xavier Street, Montreal.

Stirling, Ont.
The general contract for the erection of a Presbytery for Rev. Father O'Reilly has been awarded to F. Sheehy, Peterborough. Approximate cost, $8,000. Architects, Ellis & Ellis, Manning Chambers, Toronto.

Webb, Sask.
The general contract for the erection of a school has been awarded to More & MacWilliams, Swift Current, and work has been started. Approximate cost, $5,200. Architects, Storey & Van Egmond, McCallum Hill Building, Regina.

West Lorne, Ont.
The general contract for an addition to the school has been let to Horton Brothers, St. Thomas. Approximate cost, $7,000. Architect, W. G. Murray, Dominion Savings Building, London.

Business Buildings and Industrial Plants

Berlin, Ont.
The Carbo Corporation of Chicago intend to build a concrete plant for the manufacture of steel posts and fence supports. Particulars from City Clerk.

Brockville, Ont.
Tenders on the erection of a garage for John McCaw are being received by the Architect, A. S. Allaster, King St. Approximate cost, $5,000.

Dundas, Ont.
The Caldwell Feed Company are considering the erection of an addition to their premises. Particulars from C. W. Shosenburg.

Guelph, Ont.
Tanner & Tanner, Douglas Street, are preparing plans for an addition to the premises of the Dominion Linens Limited. Reinforced concrete construction. Estimated cost, $10,000.

Hamilton, Ont.
In connection with the erection of a block of stores and apartments for J. A. Morrow, 217 Caroline Street South, the plastering and electrical work will be done by owner.

Lacombe, Alta.
W. Burris is about to commence the erection of an office building, estimated to cost $3,500. Brick construction.

Leamington, Ont.
The Town Council are considering the erection of a Fire Hall and the purchase of a chemical engine. Clerk, R. M. Selkirk.

London, Ont.
W. G. Murray, Dominion Savings Building, is preparing plans of a garage and stables for T. F. Kingsmill, Dundas Street. White brick construction. Approximate cost, $5,000.

Oshawa, Ont.
Tenders are now being received for roofing, sprinklers, etc., required in the erection of a factory for the Chevrolet Motor Company. Architect, G. D. Redmond. Approximate cost of building, $40,000.

Port Colborne, Ont.
Tenders on repairs to elevator mooring dock will be received until noon, July 14th, by J. W. Pugsley, Department of Railways and Canals, Ottawa. Specifications at office of Chief Engineer of the Department, Ottawa and the Superintending Engineer, St. Catharines, Ont.

Regina, Sask.
Plans are being prepared for a garage to be built for Fraser & Keenleyside, 1818 Cornwall Street. Brick and reinforced concrete construction. Approximate cost, $17,000.

G. J. Tripp, Black Rock, has prepared plans of a factory to be built for the Prairie Biscuit Company, Limited. Brick construction. Approximate cost, $20,000.

Toronto, Ont.
Tenders are being received on all trades required in the erection of a garage for H. Suroff, 872 Bloor Street W. Brick construction.

Michie & Company, Limited, 7 King Street West, contemplate the erection of a large store building on Bloor Street West. Steel, stone and brick construction.

Canadian Allis Chalmers Company, Limited, 212 King Street West, propose to build a storehouse on Lansdowne Avenue, at an approximate cost of $7,000. Brick construction.

The William Davies Company, 521 Front Street E., propose to build an ice plant and cold storage, and have had plans prepared by Heuschlieu & McLaren, 431 South Dearborn Street, Chicago. Brick and concrete construction. Approximate cost, $50,000.

CONTRACTS AWARDED

Alberta Province.
The Alberta Farmers' Co-operative Elevator Company, 320 Lougheed Building, Calgary, have let the following contracts for construction of elevators, with a capacity of 35,000 bushels each: Thomas, Jamieson & McKenzie, elevators at Ribstone, Verriemur, Kinsella, Wainwright; W. S. McDonald, Calgary, elevators at Scotfield, Trochu, New Norway; Nesbitt & Millar, 211 Williamson Building, Edmonton, elevators at Meeting Creek, Innisfree, Forestburg, Edberg.

Tenders and For Sale Department

Tenders Wanted

Sealed tenders will be received up to noon on **Monday, July 10th, 1916**, for the construction of a Municipal Drain in the Township of Minto, known as Municipal Drain No. 7, approximately 12,411 feet long.

Plans, profiles and specifications can be seen at the office of C. D. Bowman, O.L.S., West Montrose, or at the office of the undersigned, to whom the tenders must be addressed.

A marked cheque for the sum of $150 must accompany each tender as a guarantee of good faith. The lowest or any tender not necessarily accepted.

W. D. McLELLAN,
Clerk of Minto,
Harriston, Ont.

Harriston, June 19th, 1916. 25-27

Tenders for Fire Alarm Signal Boxes

Tenders, addressed to the undersigned, will be received, by registered post only, up to noon on **Tuesday, July 4, 1916**, for the supplying of the above.

Sample of the box can be seen and forms of tender obtained upon application at the office of the Fire Department, Adelaide Street Fire Hall, Toronto. The usual conditions relative to tendering as prescribed by city by-law must be strictly complied with or the tender will not be entertained. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),
Chairman Board of Control.
26-26

CANADIAN GOVERNMENT RAILWAYS

TENDERS

Sealed tenders, addressed to J. W. Pugsley, Secretary, Department of Railways & Canals, Ottawa, Ont., and marked on the outside "Tender for Elevator Foundations, Transcona," will be received up to and including twelve o'clock noon, **Tuesday, July the 4th, 1916**, for the construction of reinforced concrete foundations on wood piles or concrete piles, for 1,000,000 bushel storage capacity Grain Elevator. Working House and Track Shed at Transcona, Manitoba; separate tenders to be submitted for the foundations with concrete piles and foundations with wooden piles, and tenders may be submitted on either or both designs.

Plans, specifications and blank form of contract may be seen at the office of the Chief Engineer of the Department of Railways & Canals, Ottawa; at the office of the Chief Engineer, Moncton, N.B.; at the office of the General Superintendent, Winnipeg, Manitoba; at the office of the Resident Engineer, Fort William, Ont.; and at the office of the J. S. Metcalf Company, Limited, Engineers, Montreal, P.Q.

All the conditions of the Specifications and contract form must be complied with.

Tenders must be put in on the blank form of tender, which may be obtained from any of the offices at which plans are on exhibition. Each tender must be accompanied by a certified bank cheque, payable to the Honorable the Minister of Railways & Canals, for the sum of $15,000.

The lowest of any tender not necessarily accepted.

F. P. GUTELIUS,
General Manager
Canadian Government Railways.

Dated at Moncton, N. B.,
June 17th, 1916. 25-26

Sealed tenders addressed to the undersigned, and endorsed "Tender for stone stairway, sidewalks, etc., Examining Warehouse, Ottawa, Ont.," will be received at this office until 4.00 P.M., on **Wednesday, July 5, 1916**, for the above mentioned works.

Plans, specifications and form of contract can be seen and forms of tender obtained on application to this Department, at the offices of Messrs. Thos. Hastings, Clerk of Works, Postal Station "F," Yonge St., Toronto, Ont., and R. L. Deschamps, Overseer, Central Post Office, Montreal, P.Q.

Persons tendering are notified that tenders will not be considered unless made on the forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering declines to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, June 21, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.—86827 26-26

Tenders Wanted

Separate sealed tenders addressed to S. K. Peck, Esq., Chairman, Water Commissioners, Windsor, Ontario, and marked "Tender," will be received by the undersigned up to 12.00 o'clock noon, on **Thursday, July 6, 1916**, for:—

(a) 10 tons, more or less, of specials, consisting of crosses, tees and reducers.

All according to standard specifications and adopted by Canadian Society of Civil Engineers, Class C.

(b) 6 in., 8 in., and 12 in. valves; spindles to be of Manganese bronze, open to right.

(c) 20 tons of pig lead.

(d) 35 hydrants, to bury 5 feet, having 6-in. barrel, with 2-2½-in. and 1-4-in. steamer connection.

(e) 24 extension valve boxes, 5 ft. in length.

(f) 1,000 lbs. of hemp.

All the above to be delivered f.o.b. cars, Windsor, Ont.

A certified cheque payable to the order of the Water Commissioners, equal to 5 per cent. of the amount of each section of above tenders, must accompany each tender, which cheque in case of an unsuccessful tenderer, will be forthwith returned, but in the case of the successful tenderer, will be retained until a satisfactory bond for the due performance of the work is executed, or if the successful tenderer for any reason neglects or refuses to execute a satisfactory bond within 15 days after notice that his tender has been accepted by the Water Commissioners, said cheque will be cashed, and the expense of re-advertising the work required and any additional cost in connection with the same over the amount of his tender will be retained from the proceeds of such cheque.

The right is reserved to reject any or all tenders; or to accept any tender.

The Water Commissioners
W. A. HANRAHAN, Secretary.

June 24th, 1916. 26-26

Sealed tenders, addressed to the undersigned, and endorsed "Tender for Examining Warehouse, Toronto, Ont.," will be received at this office until 4 p.m. on **Monday, July 17, 1916**, for the construction of the building mentioned.

Plans, specification and form of contract can be seen and forms of tender obtained at the office of Mr. Thos. A. Hastings, Clerk of Works, Postal Station "F," Yonge Street, Toronto, Ont., Mr. R. L. Deschamps, Central Post Office, Montreal, P. Q., and at this Department.

Persons tendering are notified that tenders will not be considered unless made on the forms supplied, and signed with their actual signatures, stating their occupations and places of residence. In the case of firms, the actual signature, the nature of the occupation, and place of residence of each member of the firm must be given.

Each tender must be accompanied by an accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. (10 p.c.) of the amount of the tender, which will be forfeited if the person tendering decline to enter into a contract when called upon to do so, or fail to complete the work contracted for. If the tender be not accepted the cheque will be returned.

The Department does not bind itself to accept the lowest or any tender.

By order,
R. C. DESROCHERS,
Secretary.

Department of Public Works,
Ottawa, June 16, 1916.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department. 25-26

FOR SALE

Two low pressure 30 H.P. steel boilers complete with mountings, grates, etc. Have been in use less than two months. Good for steam or hot water heating purposes. Each will carry 3,000 square feet of steam radiation. Further particulars—MacM. R. & D., 4 Beaver Hall Sq., Montreal. 17-t.f.

Plant For Sale

1 Smith Concrete Mixer	$400
1 Wettlaufer Mixer with Engine	250
1 20-H.P. Upright Hoisting Engine ...	450
2 10-H.P. Motors, D.C. ... ... each	85
1 30-H.P. Motor, D.C.	150

HOLMES, 1107 Yonge Street, Toronto.
22-t.f.

By slipping 24-in. wide butt-welded tires of ½-in. thick steel over the regular wheels of a paving mixer, made by the Chain Belt Company, a contractor for road construction in Glenwood, Iowa, converted the mixer into a road roller at a cost of $75. The outer half of each new tire was filled with 1 to 2 mixture of sand and cement. Samuel Friedman, the contractor, states that the converted mixer rolled the subgrade with very satisfactory results, although there were several backfilled trenches in the road. Owing to the fact that shipments of coarse aggregate for the concrete were delayed on this work, it was possible to roll the entire subgrade without using a regular roller on the job.

Bagotville, Que.
The J. G. White Engineering Company, New York, have started work on the construction of a paper pulp mill for the Ha Ha Baie Sulphite Company, Chicoutimi.

Blair, Ont.
Work has been started on the erection of stables for Miss Wilks. The contract for cement work has been let to George Haller, Preston, and for steel frame to the Metal Shingle & Siding Company, Preston. Approximate cost, $6,000.

Brantford, Ont.
In connection with the erection of a factory for the Hample Paper Box Company, the contract for concrete and brick work has been let to W. J. Springall, St. Paul Avenue; carpentry to William Hollman, Galt, and roofing and galvanized iron work to Browne Jarvis Roofing Company, 9 George Street.

The contract for installation of an elevator at the factory in course of erection for the Hample Paper Box Company, has been let to the Roelofson Elevator Works, Galt, Ont.

Cap Madeleine, Que.
The contract for structural steel required in the erection of mills for the St. Maurice Paper Company has been let to the Structural Steel Company, Montreal; contract for steel and sash to Steel & Radiation Company, 304 University Street, Montreal, and glass to Pilkington Brothers, 8 Busby Lane, Montreal.

Fergus, Ont.
The general contract for the erection of an addition to the premises of Beatty Brothers has been awarded to Wilkie & Quinn. Part of the work will be done by owners. Reinforced concrete construction. Approximate cost, $7,000.

Fort William, Ont.
The general contract for remodelling the premises of J. Wismer, 132 Ogden Street, has been awarded to F. T. Jones. Frame and brick construction. Approximate cost, $5,000.

Guelph, Ont.
The following contracts have been let for the erection of a warehouse for Hugh Walker & Son, Neeve Street:—masonry, T. W. Taylor, Eramosa Road; carpentry, George Ibbotson, Woolwich Street; iron work, McCormick & Robinson, Market Square; steel work, Hamilton Bridge Works Company, Bay Street North, Hamilton; painting, Reynolds & Son, Quebec Street; electrical work, Stephenson & Malcolm, Masonic Building. Estimated cost, $8,000.

Hamilton, Ont.
The general, masonry and carpentry contracts for alterations to the premises of N. Galbraith, 223 King Street East, have been let to John Vogan, 280 Sanford Street North. Architect, Gordon Hutton, Bank of Hamilton Building.

The general, masonry, carpentry and painting contract for the erection of an addition to the premises of the Canadian Cartridge Company, Sherman Avenue North, has been awarded to the George Frid Company, Bank of Hamilton Building; steel work to the Hamilton Bridge Works, Bay Street North, roofing to T. Irwin & Son, 22 McNab Street South, and plumbing to A. Clark, 7 Main Street West. Approximate cost, $20,000.

Montreal, Que.
The general, carpentry, steel work, roofing and plastering contracts for the erection of a store and residence block for L. A. Brochu, have been let to F. Goulet, 313 Ethel Avenue, Verdun, the heating and plumbing to G. Fontaine, 210 Plessis Street, and electrical work to O. Tardif, 695 Ontario Street, Maisonneuve. Approximate cost, $2,000.

New Glasgow, N.S.
In connection with the erection of a theatre for McCulloch & King the contract for plumbing has been let to J. Stewart, George Street, and the lighting to Picton County Electric Company, Provost Street.

Niagara Falls, Ont.
Braas Brothers, 1110 Whitney Avenue, Niagara Falls, N. Y., have commenced the erection of an extension to the premises of McGlashan Clarke Company, St. Clair Avenue. Reinforced concrete construction. Estimated cost, $20,000.

North Battlefield, Sask.
The general contract for the erection of an addition to the premises of Pickel & Johnstone, Main Street, has been awarded to Henderson & McAngus. Approximate cost, $7,000.

North Dumfries Township, Ont.
The general contract for the erection of a stock barn for John Milroy, St. George Road, Galt, has been let to Daniel McMillan. Frame construction. Approximate cost, $3,000.

Orillia, Ont.
The general contract for the erection of a factory has been let to E. Webb & Son, 76 Mississaga Street E. Local brick construction. Approximate cost, $40,000. Particulars from George Forbes, Hespeler, Ont.

Ottawa, Ont.
The general contract for the erection of a warehouse for Mrs. M. Kennedy has been awarded to I. Stewart, 252 Queen Street. Brick construction. Approximate cost, $3,000.

The general, masonry and carpentry contracts for the erection of a block of stores and apartments for A. E. Paquette, 19 Noel Street, have been awarded to A. D. Hudon, Clarkestown, Ont. Tenders on smaller trades are being received by Mr. Hudon. Approximate total cost, $12,000.

Outremont, Que.
In connection with the store and residence now being built for Hector Godin, 147 Fairmount Street W., the contract for roofing, heating and plumbing has been let to J. F. Lemieux, 2237 St. Lawrence Boulevard, and plastering to M. Thibault, Laval Avenue.

Pelham Township, Ont.
Peter Ward, R. R. No. 1, Ridgeville, has let the contract for the erection of a barn to the Metal Shingle & Siding Company, Preston. Fittings will be needed. Estimated cost, $3,000.

Quebec, Que.
The general contract for repairs to a store on St. Joseph Street for Lockwell & Leclerc, 88 St. Peter Street, has been let to E. Morissette Ltd., 234 Latourelle Street. Approximate cost, $3,000.

The general contract for the construction of a greenhouse for the Provincial Department of Public Works has been let to the Glass Garden Builders, Limited, 201 Church Street, Toronto, and the concrete work to the Sharpe Construction Company, Limited, 109 Fleurie St., Quebec. Approximate cost, $35,000.

In connection with the factory now in course of erection for the Dominion Corset Manufacturing Company, Dorchester Street, the contract for roofing has been awarded to E. Falardeau, 308 Queen Street, painting to J. M. Tardivel, 1 Abraham Hill, sprinkler system to J. Gagnon, Beauport Street, and elevator to Darling Brothers, 120 Princess Street, Montreal.

Regina, Sask.
The contract for heating and plumbing required in the erection of a warehouse for the Canadian Consolidated Rubber Company, Limited, Montreal, has been let to Potts & Smith, 1841 Cornwall St.

Saskatoon, Sask.
The general, masonry, carpentry and steel contracts for alterations and additions to the station of the Canadian Northern Railway have been let to Shannon Brothers.

St. John, N.B.
B. Mooney & Sons, 112 Queen Street, have commenced the erection of a garage for Edward Hogan, 14 Cobourg St. Brick construction.

B. Mooney & Sons, 112 Queen Street, have commenced the erection of a garage for R. W. Carson, 509 Main Street. Concrete construction.

Timmons, Ont.
The general contract for the construction of a passenger station for the Temiskaming & Northern Ontario Railway has been let to Henderson & Angus, North Bay. Brick construction. Estimated cost, $10,000.

Toronto, Ont.
The Board of Control have let the following contracts in connection with the addition to the Christie Street Car Barns: carpentry, T. Lewis, 329 Davenport Road; steel, Dominion Bridge Company, 20 Victoria Street; plumbing and heating, McNaughton & McKenzie, 1029 Shaw Street; plastering, Gander & Son, 251 Gladstone Avenue; roofing, A. Matthews Ltd., 256 Adelaide Street West; painting, J. Casey, 30 Dalhousie Street.

The general contract for the erection of a warehouse for Northrop & Lyman Company, Limited, 86 Richmond Street W., has been awarded to S. L. Yolles, 16 Madison Avenue, and the contract for brick work to Witchell & Son, 156 St. Helens Avenue. Other trades will be sub-let by the general contractor. Approximate cost, $75,000.

In connection with the block of stores and apartments now in course of erection for J. R. Gibson, Bank of Commerce, the plumbing and heating has been let to McNaighton & McKenzie, 1029 Shaw Street, and roofing to J. Gow, 177 Dundas Street.

Vancouver, B.C.
The contract for plumbing required in the erection of the station at False Creek for the Great Northern Railway has been let to James & McClugan, 601 Front Street, New Westminster.

Winnipeg, Man.
In connection with the erection of a picture theatre for Hyde Brothers, 705 McIntyre Block, the contracts for masonry, carpentry, steel work, roofing and plastering have been let to the general contractor.

Residences

Brantford, Ont.
Tenders will be received until July 3rd for heating, plumbing and electrical work required in the erection of a residence for A. A. Lister, 73 William Street.

Campbellton, N.B.
Plans are being prepared for a residence to be built on Aberdeen Street for James E. Miller. Approximate cost, $4,000.

Chippewa, Ont.
The Norton Company are now receiving tenders on the erection of twelve single and twelve double residences. Architects, Wright & Kremers, Falls Street, Niagara Falls,N.Y. Brick, stucco and concrete construction. Approximate total cost, $50,000.

Copper Cliff, One.
The Canadian Copper Company are receiving tenders on the construction of 110 frame cottages. Approximate cost, $150,000. Plans with the Company and at office of the Builders Exchange, 154 Simcoe Street, Toronto.

Hamilton, Ont.
W. E. Blatz, 187 Charlton Street East, proposes to build five residences at an approximate cost of $1,900 each, and has had plans prepared. Brick construction.

F. A. Haners, 110 Dunsmore Street, has had plans prepared for two residences which he proposes to build on Connaught Avenue. Brick construction. Estimated cost, $3,500 each.

Plans have been drawn for a residence to be built on Balsam Avenue by T. D. Barnes, 90 Jackson Street North. Brick construction. Approximate cost, $3,000.

Listowel, Ont.
E. D. Bennett proposes to build a residence on Victoria Avenue, and is preparing plans. Red pressed brick construction. Estimated cost, $3,000.

London, Ont.
The Copp Syndicate, 22 Belgrave St., have started work on four residences on Gerrard Avenue, estimated to cost $11,000. Brick construction.

Work is about to start on the erection of a residence for H. N. Abel, 61 Craig Street. Contracts will be awarded by owner. Estimated cost, $10,000.

W. G. Murray, Dominion Savings Building, has prepared plans of a bungalow for Fred Henderson, c/o. Robinson Little & Company. Brick construction. Approximate cost, $6,000.

Tenders will be received until July 3rd for the erection of an apartment house for R. H. McKnight, 296 Queen's Avenue, estimated to cost $10,000. Architects, Watt & Blackwell, Bank of Toronto Building. Brick construction.

Milverton, Ont.
John Elben, Main Street, has commenced the erection of a residence, estimated to cost $3,000. Brick construction.

Montreal Que.
M. Lapierre, 175 Champigny Street, is building four residences, estimated to cost $5,000, and is receiving tenders on roofing, plumbing and electrical work.

All work required in the erection of a residence for L. A. Clement, 338 Garnier Street, will be done by day labor under supervision of J. B. Johanssen, c/o. S. Frappier, 2238 Park Avenue. Approximate cost, $5,000.

E. Houle, 219 DeNouville Street, has commenced the erection of six residences on Eadie Street, estimated to cost $3,500. Tenders on brick work and supply of cement are being received.

In connection with the residence now being built by H. Brunelle, 122 Prefontaine Street, the plumbing will be done by owner. Electrical work not yet awarded.

New Toronto, Ont.
J. F. Brown proposes to start work shortly on the erection of a number of workmen's houses. Frame construction.

Ottawa, Ont.
James McLaughlin, 544 Gilmour Street, has commenced the erection of a residence on Wilton Crescent, estimated to cost $5,500. Brick veneer construction.

Felix McCullough, 181 Waller Street, proposes to build a block of apartments on Rideau Street, and has had plans prepared by Richards & Abra, Booth Building, Sparks Street. Tenders on smaller trades are being received by owner. Approximate cost, $15,000.

Sydney, N.S.
Tenders are being received for the erection of a residence for D. F. Nolan. Architect, A. J. McCormack, 107 Cottage Road. Frame construction. Estimated cost, $4,600.

Work is about to start on the erection of a residence on Tain Street for D. A. Noble. Architect, M. R. Chappell, Tain Street. Frame construction. Estimated cost, $6,500.

Toronto, Ont.
F. W. Hill, 55 Wolfrey Avenue, is receiving tenders on brick work and construction of a stone cellar in connection with the erection of a duplex residence on Hamilton Street. Estimated cost, $3,000.

B. J. Case, 34 Nina Avenue, has commenced the erection of a pair of residences, estimated to cost $5,000. Brick construction.

M. E. Worthington & Company, 555 Markham Street, have commenced the erection of two pairs of residences on Alton Street, estimated to cost $7,500. Smaller trades will be let. Brick construction.

Charles F. Wagner, 18 Toronto Street, is receiving tenders on carpentry work (labor only), wiring, painting, and glazing required in the erection of two pairs of residences at Balmy Beach. Brick construction. Approximate cost, $6,000.

Plans have been prepared by H. J. Chown, 220 Scarboro Road, for two pairs of residences to be built for J. Slade, 189 Beech Avenue. Brick construction. Estimated cost, $6,000.

Work on the erection of a pair of residences has been started by G. Lucas, 5 Playter Crescent. Brick construction. Approximate cost, $3,500.

Kerr & Martin, 25 Rowlands Avenue, have commenced the erection of a residence, estimated to cost $4,200, and will let smaller trades. Brick construction.

A. F. Walton, 75 Golfview Avenue, has commenced the erection of a pair of residences, estimated to cost $4,000, and will let smaller trades. Brick construction.

Plans have been prepared for a duplex residence to be built for T. B. Hughes, 140 Essex Avenue, who will let all trades. Brick construction. Approximate cost, $4,200.

H. D. Bine, 42 Appleton Avenue, has started work on a pair of residences to cost $4,500, and will let smaller trades. Brick construction.

J. L. Bartlam & Son, 62 Auburn Avenue, are receiving tenders on drain, concrete and plastering work on three residences.

CONTRACTS AWARDED

Belleville, Ont.
A permit has been issued to Miss Minnie Fleming for the erection of a residence, estimated to cost $3,000. The general contract has been awarded to P. G. Denike. Brick construction.

Guelph, Ont.
In connection with the residence in course of erection for A. J. Frank, Oxford Street, the contract for masonry has been let to J. Checkley, Alice Street, carpentry and roofing to H. Handbidge, Clinton Street, and plastering to J. J. Mahoney, Kent Street.

Hamilton, Ont.
F. A. Haners, 110 Dunsmore Street, has let the contract for masonry and steel work required in the erection of a residence, to A. Beddie, 207 Burris Avenue. Approximate cost, $5,500.

The general, masonry, carpentry, and roofing contracts for the erection of a residence for F. T. Moore, Main Street East, has been awarded to Roy Isbester, 100 Burris Avenue. Brick construction. Approximate cost, $8,000. Architect, George Hutton, Bank of Hamilton Building.

London, Ont.
The general contract for the erection of a residence on Teresa Street for T. H. Janes, Market Lane, has been awarded to R. J. Kelly, 29 Beattie Avenue. Brick construction. Approximate cost, $10,000.

Montreal, Que.
A. Cloutier, 812 Dorchester Street, has commenced the erection of a number of residences, and has let the contracts for painting to O. Perras, 1162 Henri Julien Avenue; heating and plumbing to St. Jules & Mathieu, 74 St. Viateur Street West, and electrical work to G. Martel, 229 Bernard Street. Approximate total cost, $12,800.

The general contract for the erection of an apartment house for F. Lecavalier, 65 Cherrier Street, has been let to J. Dominique, 166 Marcil Avenue; plastering to A. Morache, 499 St. Andre Street; painting to J. Rodrique, 924 Gaston Street, and electrical work to N. Marchard, Mance Street. Tenders on other trades are being received by owner. Approximate cost, $50,000.

The contract for plumbing required in connection with the residence now being built for F. Bonnier, 1639 St. Catharine Street East, has been awarded to the general contractor.

The contract for roofing, heating, plumbing, and electrical work in connection with the flats now being built by J. B. Denteneer, 244 Sherbrooke Street, has been let to J. Belisle, 808c Papineau Avenue.

Niagara Falls South, Ont.
Work has been started on the erection of a residence for Thomas Hicks, Culp Street. The general, masonry, carpentry, roofing, plastering and painting contract has been let to A. Dell, and heating and plumbing to William Read, Niagara Falls Centre. Frame and brick construction. Estimated cost, $3,000.

Ottawa, Ont.
In connection with the apartments being built by W. Shenkman, 360 Friel Street, the contract for plumbing has been let to Charles Wyman, 249 Creighton Street, and electrical work to Rideau Electric Supplies, 128 Bank Street.

Outremont, Que.
The contract for roofing, heating, and plumbing required in the connection with the cottage now being built for A. E. Fraser, 1237 Van Horne Street, has been let to J. F. Lemieux, 2237 St. Lawrence Boulevard, and plastering to M. Thibault, Laval Avenue. Carpentry by general contractor.

Renfrew, Ont.
The general contract for the erection of a residence for Thomas Cardiff, R. M. D. Renfrew, has been let to W. A. Moore, Frame and brick veneer construction. Estimated cost, $3,500.

Sault Ste. Marie, Ont.
The contract for plumbing, heating, and lighting required in the erection of a residence for R. T. Lane, 10 Queen Street, has been let to the Cochrane Hardware Company, Ltd., 388 Queen Street East.

Sherbrooke, Que.
The contract for roofing required in connection with the residence being built for T. J. Parkes, 5 Portland Avenue, has been let to J. M. Deschenes, St. Francis Street.

St. Andrews, N.B.
The contract for carpentry required in the erection of a residence for Mrs. E. C. Walker has been let to H. L. Paton & Sons, 485 St. James Street, Montreal. Remainder of work by general contractors.

St. Catharines, Ont.
The following contracts have been let in connection with the residence in course of erection for A. Robinson, College Street:—carpentry, C. F. Monk, Wilson Street; painting, Leach & Jones, James Street; heating and plumbing, J. Peart, King Street; electrical work, Barratt Electric Company, St. Paul Street.

Toronto, Ont.
S. N. Hughes, 3 Davenport Road, has awarded the contract for the erection of a residence on Lytton Boulevard to S. R. Hughes, 79 Portland Street. Brick construction. Estimated cost, $8,000.

In connection with the residence now being built for S. N. Hughes, 3 Davenport Road, the masonry has been let to W. A. Bulley, 154 Simcoe Street, and plumbing and heating to A. Welch & Son, 304 Queen Street W.

The general contract for the erection of a residence for F. Forsyth, 148 John Street, has been awarded to F. J. Tushingham, 348 Runnymede Road. The smaller trades will be sub-let. Approximate cost, $5,000. Architects, Sharp & Brown, 18 Wellington Street.

The following contracts have been let for the erection of a residence for E. J. Zavilz, 20 Lowther Avenue: masonry, F. W. Weale, 35 Lindsay Avenue; carpentry, Sider & Clarke, 356 Ossington Avenue; plumbing and heating, McNaughton & McKenzie, 1029 Shaw Street; wiring, L. P. Steele, 232 Concord Avenue.

Westmount, Que.
Anglins Limited, 65 Victoria Street, Montreal, have commenced the erection of two residences for H. A. Thomas, 100 Fort Street. Terra cotta and brick construction. Estimated cost, $25,000.

The contract for the erection of a residence for Mrs. T. Arnold, Kensington Avenue, has been awarded to A. K. Hutchinson, 10 Cathcart Street. Brick construction. Approximate cost, $25,000.

Work has been started by A. K. Hutchinson, 10 Cathcart Street, on the erection of a residence and garage for Joseph Kellert, 147 St. Luke Street. Stone, brick and reinforced concrete construction. Approximate cost, $20,000.

Windsor, Ont.
The contract for masonry, carpentry and roofing required in the erection of a residence for Percy England, Tecumseh Road, has been let to Rolls Wescott & Company, Labelle Boulevard; plastering to Biggs & Wilkie, 14 Glengarry St.; painting to J. Gaukner, Sandwich Street West; heating and plumbing to Pennington & Brian, 47 Sandwich Street W., and electrical work to Gilbert Campeau, Parent Avenue. Approximate cost, $8,000.

Woodstock, N.B.
S. Green is building a residence for Mrs. J. Hale. Frame construction Approximate cost, $3,200.

Power Plants, Electricity and Telephones

Peace River, Alta.
The Department of Public Works, Ottawa, contemplate the installation of an electric generating plant, and plans have been prepared by W. D. Cromarty, University of Alberta, Edmonton. Secretary to the Department, R. C. Desrochers, Ottawa.

Scarboro Township, Ont.
The Township Council intend to construct a hydro line on Danforth Avenue from the City Limits to Agincourt. Clerk, W. D. Annis, Scarboro.

Toronto, Ont.
The Board of Control will receive tenders until July 4th for the supply of fire alarm signal boxes. Sample and specifications at office of the Fire Department, Adelaide Street West.

CONTRACTS AWARDED

Abbey, Sask.
The contract for construction of the Abbey Rural Telephone Company's system has been let to W. D. Craig, 29 Canada Life Building, Regina. Approximate cost, $20,500.

Shackleton, Sask.
The contract for construction of the Shackleton Rural Telephone Company's system has been awarded to W. D. Craig, 29 Canada Life Building, Regina. The work will include about 66 miles of pole line, and is estimated to cost $16,000.

Toronto, Ont.
The Canada Electric Company, 165 Church Street, have been awarded contracts for wiring and electric fixtures at Bingham's Ltd., 146 Yonge Street, and for the installation of a fifty-point telephone system in the Hotel Marlborough, 214 Jarvis Street.

Weyburn, Sask.
The contract for the construction of the Weyburn Plains Rural Telephone Company's system has been let to Thomas Taylor, Parkbeg, Sask. Approximate cost, $8,300.

Late News Items

Brantford, Ont.
Tenders on the erection of a school will be received until July 3rd by J. C. Waller, 243 Brant Avenue, Chairman of the Separate School Board. Estimated cost, $12,000. Architect, L. A. Wardell, Sun Life Building, Hamilton.

Charlottetown, P.E.I.
Tenders will be received until July 5th for the erection of an addition to the City Building, estimated to cost $14,000. Architects, Chappelle & Hunter, Des-Bresay Building. Brick and stone construction.

Hull, Que.
Tenders will be received until July 3rd for the construction of asphalt and cement pavements, estimated to cost $50,000. City Engineer, J. P. A. Laforest.

Montreal, Que.
The general contract for the erection of a Church for the Ruthen Catholic Corporation, 992 Sherbrooke Street W., has been let to A. Filion & Frere, 2419 St. Denis Street, and work has been started. Brick construction. Approximate cost, $65,00.

The contract for heating required in the erection of an addition to the Telephone Exchange on Hospital Street has been awarded to James Ballantyne, 163 Nazareth Street, at $15,000.

Mount Hamilton, Ont.
Tenders on the erection of a Church for the Union Church Congregation will be received until July 6th by the Architect, F. W. Warren, Bank of Hamilton Building, Hamilton. Brick construction. Estimated cost, $9,000.

Ottawa, Ont.
The general contract for alterations to the premises of Moyneur Limited, York Street, has been awarded to Ovla Rose, 98 Water Street. Sub-tenders are being received for heating, plumbing and electrical work. Approximate cost, $8,000.

The City Council have awarded the contract for asphalt pavement on Lisgar Street to the Ottawa Construction Company, Central Chambers. Approximate cost, $16,600.

Smith's Falls, Ont.
The Board of Education have awarded the general contract for the erection of a school on McGill Street to John Davidson, Herbert Street, at $35,500. Architects, William Newlands & Son, Bagot Street, Kingston.

Toronto, Ont.
Work has been started on the construction of cribwork and a concrete wall for the Toronto Harbour Commissioners, 50 Bay Street. The contract for Section No. 1 has been let to R. Weddell & Company, Foot of Spadina Avenue, and for Section No. 2 to Dredging & Rock Company, 307 Logan Avenue. Approximate cost, $300,000.

The Board of Control will receive tenders until July 4th for asphalt, concrete and rocmac paving on a number of streets. Specifications at office of the Works Department, City Hall.

In connection with the Home now being built on Bleecker Street for the Robert Simpson Company, sub-contracts on plumbing, heating, electric wiring, terra cotta, plastering, ornamental iron and cut stone are now being received by the general contractors, Wells Brothers Company of Canada, Ltd., 96 Gould St.